ELECTRICAL REVIEW

ILLUSTRATED.

A WEEKLY JOURNAL OF

Electric Light, Power, Telephone, Telegraph and Scientific Progress.

VOL. 17, No. 23. WEEKLY.

NEW YORK, SATURDAY, JANUARY 31, 1891.

$3 per annum. Single Copies, 10 Cents.

Copyright, 1891, by ELECTRICAL REVIEW PUBLISHING COMPANY, 13 Park Row, New York.

Entered at Post Office, New York, as Mail Matter of the Second Class.

VIEWS, NEWS AND INTERVIEWS.

The man who uses the backs of telegraph blanks for figuring and memoranda will presently have a set-back. The Western Union Company is getting out a new design with the contract, which is now on the face of the blank, printed across the back. The paper of the new kind is much heavier than the old. It is estimated that about 100,000,000 Western Union blanks are used every year.

It is stated that the Chicago Board of Trade is canvassing for subscriptions among its members to build an exclusive telegraph line between Chicago and New York. A Western Union official says such a line would cost $1,250,000. Query: Does the Board of Trade know what it is about?

The eyes of many people are upon Pittsburgh, and their ears are pricked up to catch any bit of news.

A false alarm of fire recently brought nearly the whole fire department to the White House, in Washington. It was claimed that electric light wires had become crossed with the fire alarm circuit and so turned in a call. Investigation proves that such was not the case. The fire alarm circuits had been gnawed by rats and had crossed themselves—like good Catholics.

"The underground railway proposed for New York will not interfere in the least with my Staten Island tunnel scheme," said Erastus Wiman. "In fact, I think the two schemes will work together. This underground railway is especially designed for local rapid transit, while the Staten Island tunnel will aim to obviate the congested condition of passenger and freight traffic now prevalent at the railroad termini in Jersey City. I think that the 42 miles of underground railway can be built for $60,000,000, as estimated by the projectors. You know the 30 miles of Croton aqueduct only cost $32,000,000. This tunnel road will give electricity a splendid chance to assert itself."

Big men who put big money into big schemes have generally big assurances of big results.

Arban Liennimox, a Canadian strong man, is dead of heart disease. It is said that he could lift, carry, and plant alone a 40-foot telegraph pole, a feat usually requiring the labor of eight men. After planting a few such poles, is it any wonder that the strong man is now himself planted?

On the strength of Mayor Grant's report of his visit to Boston, where he inspected the overhead electric system, the Harlem Bridge, Morrisanis and Fordham Railroad Company have been given permission, by the Board of Electrical Control, to use the trolley system. This road is known to those unfortunates who are compelled to travel over it as the "Huckleberry Road," because the cars run slow enough to enable the conductors to get off, pluck a few huckleberries, which abound in the vicinity and catch the car again. Electricity will change this, and the h. b's. can grow in peace and size.

A Magnetic Paradox.

In an address to the Junior Engineering Society, Prof. Sylvanus Thompson made the following interesting remarks:

One consequence of the rule that the magnetic stress across a gap in the circuit is proportional to the square of the intensity of the magnetic flux, is the paradox that the pull exerted on an armature by an electro-magnet having a straight cylindrical core, is diminished by enlarging the surface of contact, and increased by somewhat diminishing that surface. This seems to be in direct opposition to all ordinary notions of mechanical structures; but it is, nevertheless, quite rational. If we diminish the end surface of the core, say 10 per cent., we shall produce thereby really very little difference in the total flux of magnetic lines, since the main reluctance to magnetization lies in the long return path through the air. But if the flux of magnetic lines is now crowded into a les er area, the intensity of the flux—that is to say, the number of magnetic lines per square inch—will be greater, and the square of this quantity will be, *à fortiori*, greater still. Now, the pull exerted at the surface is equal to the product of this greater square number into the diminished area of surface; and as the increase in the square of the induction is greater than the decrease in surface, the net result is that the pull is increased. Conversely, enlarging the contact surface diminishes the pull. This goes entirely against all preconceived notions of mechanical engineering; for the first instinctive impulse of an engineer, when he wants to strengthen the joint between two things, is to enlarge the surface of contact at the joint. Another strange and interesting fact is that the pull exerted upon a piece of iron by a straight electro-magnet can be considerably increased by attaching a large mass of iron to the other end of the core of the electro-magnet. This is at once explained by reference to the principle of the magnetic circuit; for the mass of iron at the idle end of the core aids in the return of the magnetic lines through the air.

Cost of Transmitting Power.

The following comparisons of the cost of transmitting power by various methods appeared in the *Revue Universelle des Mines:* 1. Comparative cost on 10 E. H. P., transmitted 1,093 yards: By cables, 1.77; by electricity, 2.21; by hydraulics, 2.90; by compressed air, 2.98. 2. Comparative cost on 50 H. P., transmitted 1,093 yards: By cables, 1.35; by hydraulics, 1.87; by electricity, 2.07; by compressed air, 2.29. 3. Comparative cost on 10 effective H. P., transmitted 5,465 yards: By electricity, 2.64; by compressed air, 4.66; by cables, 4.69; by hydraulics, 5.29. 4. Comparative cost on 50 effective H. P., transmitted 5,465 yards: By electricity, 2.37; by cables, 2.65; by compressed air 2.99; by hydraulics, 3.02. Steam was the prime motor used in each of the above instances, and it appears that for long distances electricity takes the lead in economy over all other systems. It has also a great advantage in the facility with which the power may be subdivided.

A Wild Western Invention.

A Milwaukee man has invented an electric burglar killer and alarm. It is arranged to be attached to windows, doors or safes, and it will be set in motion by opening the thing to which it is attached. It first sounds a gong which will alarm the neighbors within a mile, and if that does not scare the burglar to death it discharges four revolvers at him—at least it will be at him if he chances to stand directly in front of it; if he does not, it may be at somebody else. The device is on exhibition and the Milwaukee *Wisconsin* is responsible for the story as told above.

Gent and Company's Tempolux or Electric Watch Lighter.

Many devices have been placed before the public from time to time intending to accomplish by different methods what this firm claim to have done with their dry batteries—namely, to provide an easy, safe, and constant means of illuminating a watch or clock at any hour of the night by an electric lamp. The tempolux is a small divided case with a minute incandescent lamp and reflector fixed in the rim and made hollow so that the watch may be laid inside and the case closed up, when, upon pressing a small stud, the face of the watch will be brilliantly

ELECTRICALLY ILLUMINED WATCH.

illuminated. The source of electricity is a Gassner dry battery, which may be put away in a cupboard or other convenient place, a flexible cord reaching from it to the head of the bed or stand on which the watch is placed. The battery is free from smell, no chemicals are used in it, and it will last for this purpose for years. For persons with defective eyesight, a special watch-case with magnifying lens is provided. The makers are Messrs. Gent & Company, of Faraday Works, Leicester, England.

International Press Club Convention.

A convention of the Press Clubs of the United States and other countries is to be held at Pittsburgh this week. Mr. T. J. Keenan, Jr., is chairman of the committee, and an address of welcome will be delivered by the Mayor of Pittsburgh. It is intended, we believe, to organize an international association of which the members of the Press Clubs belonging to it will be entitled to the privileges of all the other clubs, when visiting in the different cities, not only as a matter of courtesy but as a matter of right.

The delegates of the New York Press Club are the following named gentlemen: Foster Coates and William R. Worrall, of the *Mail and Express;* T. P. McElrath, of the *American Analyst;* William Berri, of the *Standard-Union;* Charles W. Price, of the ELECTRICAL REVIEW; P. J. Hanway, chairman Board of Trustees, Press Club; W. J. Arkell, of *Judge;* J. A. Hennessy, New York correspondent Pittsburgh *Press;* Leon N. Salmon, of the *Sporting World;* Samuel C. Austin, of the *Telegram;* Thos. Evans, of the Board of Trustees, Press Club.

ABOUT ELECTRIC RAILWAYS.

MR. F. L. POPE'S INSTRUCTIVE ADDRESS BEFORE THE ELECTRIC CLUB, JANUARY 22.

The announcement that Mr. Franklin Leonard Pope would deliver an address on "The Electric Railway," brought together a number of members of the Electric Club, Thursday evening of last week, among whom was quite a sprinkling of out-of-town visitors. The parlors of the Club where the lecture was given were comfortably filled, notwithstanding the stormy night, among the gentlemen present being Messrs. O. E. Madden, Charles Dutton, Hamilton Wallis, T. J. McTighe, Wm. McM. Speer, Major E. M. Hamilton, S. L. Coles, Geo. B. Coggeshall, H. A. Reed, Geo. B. Prescott, Jr., Jos. Wetzler, P. H. Alexander, Geo. M. Phelps, Robt. H. Read, T. C. Martin, W. J. Morrison, Dr. Otto A. Moses, Chas. D. Shain, J. J. Carty, Frank W. Harrington, Herbert Laws Webb, Franck Z. Maguire.

Among out-of-town visitors were J. A. Powers, of Troy, N. Y.; J. F. Morrison, of Baltimore; Dr. M. G. Parker, of Lowell, Mass.; S. M. Bryan, Washington, D. C.

A business meeting was held at 8 o'clock, President Madden, in the chair, and the action of the Club at the preceding meeting, in changing the classification of its members, reducing fees and dues and making the limit of membership 1,000, was unanimously ratified. Announcement of an amendment to the by-laws, giving the Club power to suspend any part of the by-laws at a meeting called for that purpose, was made and under the rules went over for action at the next regular meeting.

Mr. Pope was then introduced and spoke as follows:

"Notes on the Electric Railway, Historical, Statistical and Technical."

Every trade and profession has its well worn stock of traditional anecdotes, handed down from a remote antiquity, which the veterans are accustomed to relate in hours of idleness for the amazement, or the amusement, as the case may be, of the youngsters.

The telegraphic service, in which 30 years ago I was an aspiring and ambitious youthful "plug," was no exception to the rule. You will pardon me, if I recapitulate two of these ancient tales, which I tell as they were told to me, for the sake of the moral which they point.

One of these stories was to the effect that an inventive genius down East, which meant Boston or beyond, had once contrived a great improvement on the telegraph as we knew it, inasmuch as by its means the telegraph operators, or any one else for that matter, could converse directly through the wire.

"A most magnificent invention," solemnly asseverated our chief operator, Jack Selden, "it was tried with perfect success between Boston and New York, but sad to say, it had to be given up, because the New York operator's breath smelt so strongly of bad whiskey." But in later days Alexander Graham Bell, of Boston, did actually show us how to speak through the whispering wire, and owing, let us charitably hope, to the permanent reformation of the objectionable habits of the New York operators, it did not this time "have to be given up."

The other story was about an unsophisticated old man, a shoe-maker, who lived and had a little shop in Natick, between Worcester and Boston; for aught I know, he may have been the original "Natick cobbler." The only son of this old man was a soldier in our army in Mexico. This was in 1848,

when the telegraph was a new thing and a great mystery, and its frequent dispatches, bringing the latest news from the seat of war, kept the community in a continual state of feverish anxiety, of which in later years we all came too well to know the full meaning. One day a letter came to the shoemaker from his son, complaining of the condition of his boots, worn to shreds by long and hard marches, and wishing that he had a durable pair of the paternal manufacture. Struck with a happy thought, the good old man immediately constructed a pair of his very best No. 12 cowhides, affixed a tag to them inscribed with the proper address, tied the straps together and hung the boots over the telegraph wire which passed his house. In the morning they were gone. A belated tramp had appropriated them, and with a certain sense of grim humor not unknown among these gentry, had hung his own delapidated brogans in their place. "Look, Marthy," exclaimed the delighted cordwainer the next morning, as he gazed out of his window in the dim light of dawn, "Johnny has got his new boots so quick, and has sent his old ones back by telegraph to be mended."

But, to-day, the improbable romance of the talking wire, and the imagined electrical transportation of the simple cobbler of Natick, have both become realities. The speaking telephone is found in every business office and in almost every home. Freight and passengers are hauled over elevated ways by invisible electric power, and probably no one in this audience entertains a doubt that the day is close at hand when the electric transportation of passengers will be conducted at a rate of speed which most people now deem almost inconceivable.

Every consideration of common humanity, not to speak of public convenience and economy, unite to urge the speediest possible substitution of mechanical for horse power on our numerous street railways, and this is for many reasons especially to be desired in cities in which the most desirable residential neighborhoods can be reached only by routes including long and comparatively steep ascending grades. It is but just to the street railway managers of the United States to say that these considerations have not been without effect.

It is only six years ago that an electric street railway was put in actual commercial service in the United States for the first time. This was in the city of Cleveland, O. To-day considerably more than one-third of the total street railway mileage of the United States is either operated by electric power or contracts have been entered into for the substitution of an electric equipment for that now in use, at the earliest possible moment.

At a meeting of the American Street Railway Association, held in Washington, only a little more than two years ago, almost the sole subject of discussion was the question of improved motive power for street railway service. Every manager and superintendent present realized that the demands of traffic were rapidly outgrowing the existing methods, and many of them had begun to look forward to the application of electric power as the only possible solution of the problem. As one delegate after another reported his experiences and observations in respect to electric traction, a member who had listened to it all with evident impatience, arose and entered his solemn protest against all the new-fangled talk about electricity. He said that he had come there upon the assumption that it was a horse railroad convention, in order to get information about horses. He wanted to know how to shoe them, how to feed them, and how to work them to the best advantage. And as he continued to complain, it was evident that in more than one place in the assemblage his ideas met with a sympathetic response.

Less than four months ago, the same association held its annual meeting at Buffalo, and in his opening address, the president, Thomas Lowry, of Minneapolis, made the following significant remark:

"I am so thoroughly convinced that electricity is the coming power for street railways (except on very heavy grades, where the cable is best suited), and that it will prove so effective as a means for rapid transit for cities, that I believe that this is the last convention that will ever seriously consider horses for the operation of street railways."

Nor was this all. Many of you who are familiar with the fact that President Lowry, whose energy, ability and foresight will never be questioned by any one familiar with his career, threw away, in 1889, a bran new cable plant, which cost nearly half a million dollars, in order to replace it with electric motors.

Some of his associates undoubtedly entertained grave doubts of his sanity, but every new electric road brings a fresh tribute of approval to his enterprise and to his courage. Since he took that memorable action, electricity has changed the whole aspect, both scientific and commercial, of municipal transportation.

Few people have any conception of the enormous extent of city and suburban traffic in the cities of the United States. A few statistics are more impressive than pages of rhetoric.

The official returns show that during the year ending September 30th, 1889, the 110 street railways in the State of New York, carried over 686,000,000 passengers, or 100 times the total population. In New York city alone the surface and the elevated roads carried together about 400,000,000. In Boston, 100,000,000, and in Philadelphia, 150,000,000 passengers were carried. In fact, statistics indicate that the street railways of the United States carry something like twice as many passengers as all the steam roads, and moreover, it has also been found that the number of passengers increases from year to year in a much greater ratio than the population, which means, not only that more people ride, but that the same people ride more frequently each succeeding year.

The transportation of this enormous number of passengers; probably not less than four or five billions, taking the whole country together, with safety, comfort, speed and economy, must be recognized as an undertaking of the most gigantic description. It is well worth our efforts to carefully consider the best means by which it can be accomplished. No work has ever been done by the inventor, the engineer or the electrician, of such immediate and direct benefit to the masses, as that which has to do with the subject under consideration.

Considered in a general sense, the electric car is a self-propelling vehicle, the actuating force of which is derived from an electric current, through the agency of an electric engine, or, as it is technically termed, a motor. We may conveniently consider the subject of electric railways by dividing them into three classes, which are distinguished from each other in the manner in which the current is supplied to the motor upon the car. These are:

First. The so-called *overhead* system, in which the electric current is supplied to the car through a wire suspended above the track.

Second. The *underground* system, in which a supply conductor is placed in a conduit beneath the surface of the street, and the current is taken into the car by an arm projecting downward through a slot in the top of the conduit.

Third. The *storage battery* system, in which the current is furnished by storage batteries (which are in fact a species of electrical reservoirs) placed underneath the seats of the car and charged at the terminal station with a sufficient quantity of electricity for each trip.

While differing from each other in respect to the manner in which the current is supplied, certain essential principles are common to them all. In all electric cars, the motor is composed of a stationary portion, called the *field-magnet* and a moving portion called the *armature*. The electric current causes the armatures to revolve, and the armatures being geared to the car-axles move the car. The driver starts the car by establishing an electric connection between the motor and the electric conductor, overhead or underground, or the storage battery, as the case may be, stops the car by interrupting the electric connection, and reverses it by reversing the direction of the current which passes through the motor.

The time which I have allowed myself will not permit me to enter as fully as I should like into the history of the electric motor, but there are certain prominent epochs in its development, which requires a passing notice.

The discovery that it is possible to produce continuous mechanical motion, by the agency of the electric current, is due to an eminent English philosopher. It was made early on the morning of December 25th, 1821. For many years this discovery was regarded as nothing more than an interesting philosophical experiment, but the world is now awakening to some adequate conception of the magnificent possibilities of the humble gift which was slipped into its stocking on that Christmas morning, by one who had not long before jocosely described himself as "Michael Faraday, late bookbinders' apprentice, now turned philosopher."

In 1831, Joseph Henry, then Professor of Natural Philosophy in the Academy at Albany, N. Y., and afterwards the distinguished secretary of the Smithsonian Institution at Washington, in a letter to Professor Silliman, of New Haven, said: "I have lately succeeded in producing motion by a little machine which I believe has never before been applied in mechanics, by magnetic attraction and repulsion." This was a crude and simple affair, but served sufficiently to illustrate the principle of such apparatus. Those who are interested to see it will find it carefully preserved in the cabinet of Princeton College.

After having thus demonstrated the possibility of constructing an electro-magnetic engine, so far from giving way to the natural enthusiasm of the successful inventor, Henry proceeded, with that calm sobriety of judgment for which he was peculiarly distinguished, to forcast the future possibilities of the new motor. He was soon led to see that under the conditions of knowledge then existing the power could only be derived from the oxidation of zinc in a galvanic battery, and hence the heat energy required in the original smelting of the metal must represent at least an equal amount of power. Hence his conclusion that the fuel required for that purpose might with better advantage be employed directly in performing the required work.

While feeling thus assurred that electricity could not hope to compete with, much less to supersede, coal, as a primary source of power, Henry, nevertheless, did not hesitate to predict that the electric motor was destined in the future to occupy an extensive field of usefulness, particularly in applications in which absolute theoretical economy was subordinate to more important considerations.

Time has shown that Henry's conception of the legitimate field of the electric motor was prophetically accurate, but his views failed to impress themselves upon the minds of his contemporaries. In the expectation that electricity would soon be the universal motive power, the problem of its utilization was, during the next ten years, attacked with great zeal by a considerable number of inventors. The earliest, as well as the most meritorious of these, was a Green Mountain village blacksmith by the name of Thomas Davenport. Some time since, while preparing a lecture to be delivered before the Board of Trade, in Springfield, Mass., I accidentally learned that this inventor had constructed a model of an electric railway in Springfield more than 50 years ago, undoubtedly the very first appearance of the electric railway in the history of the world. The work of this pioneer electrician, and even his very name, being almost unknown to the present generation of laborers in this fertile field, my curiosity and interest was sufficiently excited to lead me to undertake an investigation, with a view to rescue whatever knowledge of his work had escaped the ravages of time. In this it has been my fortune to meet with an unexpected degree of success. The record of his career shows that Thomas Davenport was a man of no ordinary merit. Pursuing the occupation of a village blacksmith in Brandon, Vt., at that time an obscure country town, far removed from all main lines of travel and transportation, and long before the day of railroads; but as Professor Eaton justly said of him, "possessing one of those minds which cannot be confined to the limits of a blacksmith's shop, nor any other shop less than the canopy of heaven," he had no sooner been shown as a curiosity the effect of Professor Henry's electro-magnet in lifting a blacksmith's anvil by the magnetic power generated by three small battery cells, than he was seized with the idea that electro-magnetism might be applied to the propulsion of all kinds of machinery, and in fact might be made a universal motive power. From that moment his whole life was devoted solely to the realization of this conception.

It has been well said that "to rightly appreciate a discoverer we should not look at his work from our time; we should not judge of his work in the fullness of the light of present knowledge; but in the dim twilight which alone illuminated to him facts and laws then but imperfectly known." We must remember that at that date the steam engine was a comparatively uneconomical, inefficient and dangerous apparatus, and was regarded at best but a necessary evil; a thing to be tolerated and endured in the absence of available water-power, but best dispensed with altogether wherever possible. At that time and for years afterwards the annual catalogue of disasters by fire and explosion due to the use of steam was a lengthy and horrifying one. The report of a single year of the St. Louis Board of Trade gave a list of no less than 112 steamers which had been destroyed on the western rivers within the preceding 12 months by fire and explosion. Many people now living will remember the circumstance of over 60 persons being instantly killed by the bursting of a steam boiler in the heart of the business district of New York city. With such facts as these in mind it is easy to understand why the possibility of a new motor, compact, noiseless, manageable, free from all danger of fire and explosion, should be hailed with enthusiasm as a priceless boon to the industrial community. We must remember, too, that there existed at that time no data from which could be foreseen or determined, even with remote approximation, the relative economy of steam and galvanic power. It was not until ten years later that the great law of the conservation of energy and the correlation of the physical forces—now familiar to every schoolboy—was first formulated by Grove and Mayer and Joule; a law now so interwoven with our scientific conceptions that it is hardly possible for us to imagine that it could ever have been unknown. At a much later date than that of which I am now speaking, men whose names will be recognized as the foremost scientists of the time, such men as Lardner, Jacobi and Joule, did not hesitate to put upon record the conviction that within a few years the power of steam would be wholly superseded by that of electro-magnetism, and the *Scientific American* was publishing illustrated descriptions of perpetual motion machines.

From the moment in which he first witnessed the experiment of lifting an anvil by Henry's electro-magnet to the very last hour of his life, Davenport never once wavered in his belief that steam was ultimately destined to be supplanted by electro-magnetism. Within six months from that time, with the assistance of another mechanic of the same town, he succeeded in constructing a machine by which he obtained continuous rotation by electro-magnetic power. And it is worthy of remark that in this very first machine, Davenport exhibited that unerring instinct of genius which ever distinguishes the true inventor, in that he grasped at once the fundamental conception of the combination of fixed and rotating electro-magnets, the one reversible and the other non-reversible, which has characterized every commercially successful electric motor from the beginning until the present day. Time does not permit the rehearsal of the detailed story of his struggles, his failures and his successes. During the six years between 1835 and 1841, he built more than 100 operative electric motors, scarcely any two of which were of the same design, and which varied in size from a small model up to an engine capable of driving a rotary printing press for 12 hours in succession. In December, 1835, he exhibited in Boston, the model of an electric locomotive and circular railway which he had built in Springfield, and a similar though more finely finished model which was built by him the following year, is still in existence in a good state of preservation. He published in 1840, now more than 50 years ago, in the city of New York, a weekly journal called the *Electro-Magnet and Mechanics' Intelligencer*, which was printed upon a press driven by an electro-magnetic engine. Some of his motors, constructed as early as 1837 and 1838, were admirably designed, and in essentials, even to the shunt winding, differed but little from some of the most advanced and successful types in use at the present day.

Less than a year before his death, upon reading a newspaper account of the trial of the large engine built at Washington by Charles G. Page under an appropriation from Congress, Davenport wrote a long and interesting letter to a local newspaper, congratulating Professor Page upon his success, giving a concise but full account of his own work, and predicting with an earnestness born of entire conviction, the ultimate triumph of electro-magnetism over steam.

It has been the fashion to smile at such men as Davenport as enthusiasts. But may it not be that there is another side to the question? I do not forget that one of the greatest of American philosophers, Joseph Henry, has said: "The man of true genius never lives before his time. Though he may catch a glimpse of the coming light as it gilds the mountain top, long before it has reached the eyes of his contemporaries, and though he may hazard a prediction as to the future, he acts with the present." Viewed in this light, it may be said that Davenport did not live before his time. At least he *acted* with the present. It may be affirmed with entire truth, that he gave every effort of his life to the development of his idea, and at last sunk into his grave, as he himself well realized, a victim of disappointed hopes. Yet, if Davenport was an enthusiast, so are we all enthusiasts as respects our anticipations of the realization of the result which he predicted and for which he wrought unceasingly. Steam is nothing more than a convenient agency for the *transmission* of power, which derives its energy from heat and imparts it to mechanism. So soon as the great riddle of the day has been read—the production of electricity, as steam is produced, directly from heat—then, indeed, will the predicted triumph of electro-magnetism over steam become an accomplished fact. Forty years have passed away since all that was mortal of Thomas Davenport was laid to rest beneath the Brandon elms, yet I think there are not many present in this audience to-night who do not cherish the expectation, if not the conviction, that before the half century has been completed the great problem will have been solved, and the era of a new industrial revolution will have dawned upon the world.

The electric locomotive constructed by Professor Page, which was tried by him on the Baltimore & Ohio Railroad, in 1851, deserves a passing notice here. It was a noteworthy achievement, but developed no new principle, nor did it contribute anything to the ultimate solution of the problem of the electric railway. Many other promising experiments were made, but all resulted in failure, until the very name of electro-magnetic motor became almost a synonym for "humbug." In discussing the question Professor Henry once said in his prophetic way:

"All attempts to substitute electricity or magnetism for coal-power must be unsuccessful, since these powers tend to an equilibrium from which they can only be dis-

(Continued on page 280.)

OUR EUROPEAN LETTER.

INTERESTING NEWS FROM ENGLAND, IRELAND, BELGIUM AND FRANCE.—A RETROSPECT OF ENGLISH ELECTRICAL WORK.

The Beginning of a new year necessarily causes the mind to wander back to the various advances, developments and discoveries which the preceding 12 months can show in the different branches of electrical science, lighting, traction and telephony. In the metropolis the use of the electric light has very greatly increased, the total number of incandescent lamps supplied from central stations and private plants being equivalent to 264,000 of eight candle-power and about 1,000 arcs. The building of a central station for the supply of 10,000 lamps by the St. Pancras Vestry, the pioneer London local authority to adopt such a course, is a step in the right direction. I gave full particulars of the work intended in a recent letter.

For **Provisional Orders** under electric lighting acts of 1882 to 1890, there has been considerably less application, the figures reading 161 in 1889 and only 70 in 1890.

In **Electric Traction** the steps have been more strikingly important. The City and South London Electric Railway was opened to passenger traffic on the 18th December last, and I have given you full particulars in some of my later letters. In the face of great difficulties Englishmen have brought out the first real electric railway. In tramway traffic in July last a service of accumulator cars was inaugurated on the Birmingham Central Tramway Company's lines, and at the end of 12 months' working, Mr. J. Smith, the chairman, has promised to publish actual results as to life of cells and cost of maintenance, whether favorable or adverse to accumulator traction. On a section of the West Metropolitan Tramway Company's lines, an improved Lineff closed conduit system is about to be put into operation; and the London Tramways Company have already equipped two cars with the Jarman system of accumulator traction, but have not yet made practical use of it. The bill for the proposed Central London Railway will be before the House of Commons in the present session, as well as the applications for the line from the city to the Angel, Islington, and another from South Kensington to Paddington. The completion of the Liverpool overhead electric railway is expected towards the end of the year.

In **Telephony** the most important result of the last 12 months was the expected opening, with the beginning of the year, of the line which is to connect Paris with London. The opening has, however, been postponed and is announced for the third or fourth week in January. The expiration of the Bell telephone patent and the near expiry of the Edison, have exercised many minds as to what course is likely to be taken by the government authorities; but red-tapism and conservatism are always slow to act until private enterprise has put to shame.

The **Electrical Exhibition** of the year, the Edinburgh International, was, from a commercial point of view, a failure; but it was an undoubted success, in so far as its demonstration to the millions of visitors of the practical uses of electricity for lighting and as a motive power, and also for the propulsion of tram-cars and launches. Over 70 members of the Institution of Electrical Engineers held their meeting at the exhibition, a happy union of pleasure and business.

Electrical Standards Committee.—For the consideration of what steps should be taken for the providing of electrical standards, a committee has been appointed by the president of the Board of Trade. Representing the Royal Society are Lord Rayleigh, F. R. S., and Sir William Thomson; for the British Association for the Advancement of Science, Professor G. Cary Foster and R. F. Glazebrook, F. R. S.; for the Institution of Electrical Engineers, Dr. J. Hopkinson, F. R. S., and Professor W. E. Ayrton, F. R. S.; for the General Post Office, E. Graves, Esq., and W. H. Preece, Esq., F. R. S., and for the Board of Trade, Courtenay Boyle, Esq., C. B., and Major P. Cardew, R. E. Sir Thomas Blomefield, of the Board of Trade, is secretary to the committee, who will hold their first meeting at the Board of Trade on the 15th inst.

Great Fire in London.—There was a very disastrous fire in Queen Victoria street last week, the damage being estimated from half a million to £600,000. Several large buildings were burnt out and as showing the dangers of overhead wires, a large iron standard carrying some 20 to 30 telephone wires crashed through one of the roofs; most fortunately none belonged to the light circuits. The new showroom of the Gulcher Electric Light Company and the London office of Messrs. Davey, Paxman & Company, were both attacked, but this will not interfere with the business of either firm.

City and South London Railway.—The working of the railway up to the present time has been most successful, it having been at times so impossible to carry the number of passengers desirous of traveling that booking has had to be stopped so that the platforms might be cleared. There has been, up to present, but one electrical hitch—the slipping out of a connection, and as many of the trains have been greatly overcrowed, which, by the bye, ought, under no circumstances, to be permitted—the working powers have been strained to the very utmost. For a few weeks there will be no running of trains on Sundays and an early stoppage on week days to enable the whole system to be thoroughly examined. For the maintenance of a five minute service in each direction eight trains are required, each of which will run 10 miles per hour, or 1,400 miles per day, for the eight trains, which, with continuous operation for 17½ hours daily, will give a yearly mileage of 511,000 miles, yielding to Messrs. Mather and Platt, at the contract price of 3½*d.* per mile, £7,452 1*s.* 8*d.*

The South Kensington and Paddington Railway.—The promoters of this scheme, who earty last session withdrew their bill, have made important amendments, and again deposited their bill for the construction of a subway from the Exhibition Road, South Kensington, to the Bishop's Road Bridge of the Great Western Railway at Paddington. The capital required is £276,000, in respect of which there will be power to borrow a further £92,000. The Corporation of the Hall of Arts and Sciences do not appear to favor the scheme, believing the railway would seriously interfere with the scientific instruments under their charge.

The Royal Naval Exhibition.—The electric lighting committee, consisting of Sir William Thomson, Capt. Eardley Wilmot, R. N., Mr. E. H. Carbutt, Mr. W. H. Preece and Mr. J. T. Thorneycroft, have entrusted the entire lighting of the exhibition to Messrs. Siemens Bros. & Company, who will furnish dynamos and lamps. Messrs. Willans & Robinson supply the engines and the boilers for the electric light, and for the machinery in motion are to be used those of Messrs. Davey, Paxman & Company. The committee intend to make the electric lighting as brilliant an affair as possible. There are to be 1,700 incandescent lamps and 400 arcs. There will be several interesting applications of the transmission of power for which the dynamos must supply current as well as for the lighthouse of Messrs. Chance Bros., which will be one of the chief features of the exhibition.

Mr. William Lant Carpenter.—The unfortunate circumstances attending the death of this well-known and highly respected scientist and philanthropist, on the 23d ult., added an additional sorrow to a great loss. He was a son of the late Dr. W. B. Carpenter, the eminent physiologist and author, and had always shown the most active zeal in connection with educational work, principally science. By profession a mechanical engineer, he was manager of the school of electrical engineering in Prince street, Hanover Square, W., but, owing to failing health, he had not for some months taken any part in the management. Born in 1841, he has left, at the early age of 50, four children to lament and a host of friends to regret his loss. He was a batchelor of science, London University, and had published in book form several most interesting courses of lectures. It is probable that the school of electrical engineering will be carried on under the management of Mr. Drugman, who has been in charge during Mr. Lant Carpenter's illness.

Electric Motors at Kensington.—Mr. John Barker, who has for some months past been using electricity for the lighting of his Universal Stores, in High street, Kensington, has now decided to employ electric motors for coffee grinding, chaff-cutting and other purposes. They are to be driven off the Crompton circuit.

Electric Light for Post Office Work.—Owing to the general complaints of the sorters and other officials working long and late hours, as to the great discomfort caused by the heat of the gas, it is stated the authorities now contemplate installing the electric light at the Bristol general post office. Once made a fair trial of, the general adoption becomes only a matter of time.

How Telephony is Progressing in France.—At the end of last November Paris telephones had 9,200 subscribers; Lyons came next with 800; Marseilles, 600; Bordeaux, 500; Lille, 450, and Reims, 400.

Brussels.—The Belgian Society of Electricians have begun their series of public lectures in the rooms of the Engineers' Society in the Palais de la Bourse. In an opening address the president, M. Wybauw, spoke of the changes electricity had imparted into all scientific studies and of the necessity any engineer was under to keep himself thoroughly informed of what was being done in this relation by new science. The first lecture was given by Captain Eugene Lagrange (of the engineers), a lecturer at the military school, on the history of electrical science. It was embellished with numerous interesting anecdotes, and gave the greatest pleasure to all those present. Experimental demonstrations are to be added to the succeeding lectures, which must tend to their popularity and success.

Moscow-French Exhibition, 1891.—A concession from the Czar has been granted to a committee of French merchants and manufacturers, for an exhibition to be held from May to October, this year, and devoted exclusively to productions of the French nation. Electricity will form one of the sections, and the lighting, which is to be done throughout by electricity, has been given to one of the leading Parisian companies.

Notes.—Mr. F. C. Bell has resigned the manager-directorship of Bell's Asbestos Company (Limited). Application has been made to the committee of the Stock Exchange to allow the shares of Elmore's French Patent Copper Depositing Company to be quoted in the official list. The Brush Electrical Engineering Corporation, of Belvidere Road, Lambeth, are opening a city show room in Queen Victoria street, E. C., nearly opposite to the Mansion House station of District Railway.

CHARLES FFRENCH.

London, Jan. 2d, 1891.

The Frey Magneto-Electric Brake.

This is a convenient little contrivance for checking the swing of the needle or system of a fibre suspension galvanometer, by sending a slight induced current through the coils, the effect of which is to tend to swing the system in a direction opposite to that in which it is moving. The current being slight and capable of being nicely regulated,

the deflection can be readily brought to zero. This instrument consists of a coil, the terminals of which are connected with the galvanometer through a contact key. A small bar magnet is pushed or pulled through the coil. This apparatus is an invention of Mr. Charles P. Frey, and is being placed on the market by The E. S Greeley & Company, of New York.

A Very Successful Wire Manufacturing Company.

The International Okonite Company (Limited), New York and London, has declared a dividend for the six months ended December 31st, 1890, on the capital stock of the company at the rate of eight per cent. on the preference and ten per cent. on the ordinary shares. This company is the consolidation of the Okonite Company, of America, and Messrs. Shaw & Connolly, of England, both prominent manufacturers of insulated wires and cables for electrical purposes. This liberal dividend shows an immense business done by the International Okonite Company during the first six months of its existence, and reflects great credit on the American management, where the bulk of the business has been secured.

The manufactury at Newton Heath, Manchester, England, is rapidly nearing completion, and the necessary machinery is nearly all ready for delivery. When this addition to the existing works comes to be fully developed, a noticeable increase in the English business is looked for. The company handle Okonite insulated wires and cables for aerial, underground and submarine electrical purposes, also Candee and Manson wires. These goods will be vigorously pushed abroad, where their popularity is nearly if not quite as great as in this country.

Waverly, Kan.—Midland Telephone Company; capital, $10,000.

Akron, O.—Schlegel Electric Clock Company; capital, $10,000.

Lincoln, Neb.—The Lincoln Electric Supply Company; capital, $50,000.

Bozeman, Mont.—Bozeman Electric Street Railway Company; capital, $60,000.

Washington, Ill.—The Dun Electric Light and Power Company; capital, $12,000.

Malden, Mass.—The Bell Rock Electrical Conductor Company; capital, $500,000.

Stafford Springs, Conn.—The Hyer-Shahan Electric Motor Company; capital, $25,000.

Birmingham, Ala.—The Stevens Electric Company has increased its capital stock to $50,000, and contemplates putting additional machinery in its electric light plant.

Chicago, Ill.—The Chicago Incandescent Light Company, for the manufacture of electrical supplies; capital stock, $15,000; incorporators, C. S. Olmsted, E. S. Osgood and H. R. Husted.

Indiana, Pa.—An electric light company with $30,000 capital has been formed. Directors, W. B. Kline, Ed. Row, H. M. Bell, W. S. Daugherty and G. P. McCartney. J. Wils McCartney is treasurer.

Birmingham, Ala.—G. W. Beggs and J. E. Lee, of Bessemer, and H. T. Beggs have incorporated the People's Electric Light and Gas Company, for electric and gas lighting purposes. The capital stock is $100,000.

The Way it Looks.

[From the *Journal of Finance.*]

What a cheap lot of "business men" they turn out to be in Pittsburgh, who, after long and loud hurrahing, "pledged" $500,000 to help a temporarily embarrassed townsman. They were given ample collateral; they assumed practically no risk. But the sensation of doing something like real men seems to have overpowered them, and without notice they withdrew all their pledges. These eminent financiers ought to copyright their special style of doing things contemptible, for if Hungry Joe should venture into Pittsburgh he might, discovering, finally, his ideal, be tempted into plagiarism.

The Austrian Government and Electric Lighting.

At Vienna, the International Electricity Company has been commissioned by the Ministry of Finance to carry out an installation of electric lighting and of a separate plant for the electrical transmission of power for the purpose of working printing machines for the government printing office at Rennweg. In both cases the transmission of the power will be effected by means of this company's cable system.

On the 31st ult. the electrical plant of the International Electricity Company in Fiume was set at work. With reference to the erection of this plant, the company lately entered into negotiations with the authorities of Fiume, who, however, refused to grant a concession for the erection of a central station by reason of a protest made by the gas company of Fiume. A suitable site was, however, granted to the company for the recent installation carried out on behalf of the Hungarian government, and the plant, by means of which the railway station in Fiume is electrically lighted, and power transmitted for the working of the lifts of the Hungarian State Railway, will become enlarged into an important central station for these purposes on government land. The International Electricity Company will also carry out the electrical lighting of the festival room in the School of Arts on the occasion of the artists' festival and exhibition which is held in connection with it, at the approaching carnival.

ELECTRICAL REVIEW

Published at 13 Park Row,

P. O. Box 3329. NEW YORK.

EDITORS:

GEO. WORTHINGTON. CHAS. W. PRICE.

ASSOCIATE EDITORS:

ROBT. H. READ. STEPHEN L. COLES.

BUSINESS STAFF:

GEO. WORTHINGTON, *President.* CHAS. W. PRICE, *Secretary.*

ROBT. H. READ, *Manager Patent Bureau.*

H. T. RICHARDS, *Mgr. Advertising Department.*

REGISTERED CABLE ADDRESS:

"ELECTVIEW," NEW YORK.

"1546 CORTLANDT," TELEPHONE CALL.

BOSTON OFFICE:

W. I. BARKER, Room 29, 620 Atlantic Ave.

WASHINGTON OFFICE:

GEO. C. MAYNARD, 1409 New York Ave.

CHICAGO OFFICE:

D. B. DEAN, 163 Randolph Street.

EUROPEAN OFFICE:

CHARLES FFRENCH, Editor for Europe.

HOTEL VICTORIA,

Northumberland Ave., Charing Cross, London, W. C.

Cable Address: - - "Electview," London.

Telegraphic Address: Ffrench, "Victoriola," London.

SUBSCRIPTION TO THE ELECTRICAL REVIEW.

One Year, United States and Canada, - $3.00

One Year, Foreign Countries, - - 5.00

Single Copy, - - - - .10

ANNOUNCEMENT.

Address all communications and make all money orders and checks payable to order of ELECTRICAL REVIEW, P. O. Box 3329, New York.

No attention will be paid to communications for the REVIEW without the *name and address of the writer.*

NEW YORK, JAN. 31, 1891.

CONTENTS.

	PAGE.
Views, News and Interviews	271
A Magnetic Paradox	271
Cost of Transmitting Power	271
A Wild Western Invention	271
Gent and Company's Tempolux or Electric Watch Lighter	271
International Press Club Convention	271
About Electric Railways	271
Our European Letter	273
The Frey Magneto-Electric Brake	273
A Very Successful Wire Manufacturing Company	273
New Corporations	273
The Way it Looks	273
The Austrian Government and Electric Lighting	273
Severe Storm	274
Mr. Pope's Able Lecture	274
Rapid Transit for New York	274
Book Notices	274
Correspondence:	
Our Boston Letter	275
Our Chicago Letter	275
Our Albany Letter	275
Progressive Electrical Inventions	275
The Biggest Rapid Transit Scheme Yet Proposed	275
The Board of Electrical Control	275
Exhibitors at Providence	275
New York Gas Commission	275
Telephonic News	276
The Telephone in France	276
The Resistance of the Atmosphere	276
The London-Paris Telephone	276
"Modern Uses of Electricity"	276
Ball Engines to be Made in the East	277
A Novel Velocipede	277
Electricity in Wine Making	277
Telegraphic	277
Old Bogy, the Tramp Operator	277
Electric Power	278
Description of the Ongley Electric Register and Safety Signal System	278
Annual Meeting and Report of the Edison General Electric Company	278
Brooklyn Lighting Contracts Awarded	279
Electric Light News	279
Electric Mutual Insurance Company	281
Electric Clubs:	
New York Electric Club	281
Institute of Electrical Engineers	281
Suit Against a Smelting Company	281
Kindred Interests	282
Brush Electric Company	282
Westinghouse Affairs	282
Financial	282
Electrical Patents	282

INDEX OF ADVERTISERS.

COVER PAGES. PAGE.

Ansonia Brass & Copper Co. xxiv
Armington & Sims. xxiv
Bridgeport Brass Co. xxiv
Brush Electric Co. xxiii
Davis, Charles H., Electrical Engineer. xxiv
Day's Kerite Insulated Wires. xxiv
Eastern Electric Cable Co. xxiv
Hampson & Co., E. P. xxiv
Jewell Belting Co. xxiv
Moore, Alfred F. xxiv
National Electric Mfg. Co. ii
Okonite Co. xxiv
Simplex Electrical Co. xxiv
Standard Underground Cable Co. xxiv
Tucker Electrical Construction Co. xxiv
Wilmot & Hobbs Manufacturing Co., The. xxiv

INSIDE PAGES.

Alexander, Barney & Chapin x
American Bell Telephone Co. xv
American Circular Loom Co. xiii
American Electrical Works xiii
Baker & Co. xviii
Barnes Co., W. F. & John vi
Baxter, H. E. & C xvii
Berlin Iron Bridge Co. iii
Bernstein Electric Co. vii
Billings & Spencer Co. xx
Brownlee & Co. vii
Bubier Publishing Co. xvi
Buckeye Engine Co. xx
Burton Electric Co. xvii
Cary, Alanson. x
"C. & C." Electric Motor Co vii
Central Electric Co. x
Chadbourne, Hazelton & Co xviii
Consolidated Electric Storage Co., The. vi
Crocker-Wheeler Motor Co. xx
Crosby Electric Co. xii
Detroit Electrical Works iii
Dwight Slate Machine Co. xvii
Edison General Electric Co. viii
Empire China Works xx
Empire City Electric Co. iii
Faraday Carbon Co. xvii
Field Engineering Co. xxi
Fletcher & Fletcher Electric Co. xviii
Fort Wayne Electric Co xxii
For Sale—Glow Lamp Patent xiii
Foundry and Machine Dept. Harrisburgh Car Mfg. Co. vi
Garvin Machine Co. xvi
Gas City Electric Co. ix
Gethins Electrical Mfg. Co. xi
Gordon & Co., W. H xvii
Greeley & Co., The E. S. xvii & xxi
Haasenstein & Vogeler xiii
Heisler Electric Light Co. xi
Holmes, Booth & Haydens. xiv
Holtzer-Cabot Electric Co. x
Industries xviii
Independent Bung Co. xiv
International Aluminum Works xviii
Interior Conduit & Insulation Co. vi
Lane & Bodley Co. xvii
Law Telephone Co. xiii
Leclanche Battery Co. xiii
Leffel & Co., James. xvii
Lehigh Valley Creosoting Co. xvi
Maguire, F. Z. xiii
Marshall, Wm. xvi
National Carbon Co. vii
National Electrical Mfg. Co xxii
New England Butt Co. x
New York Belting and Packing Co. xvii
New York Insulated Wire Co. xv
Noye Mfg. Co., John T. x
Otis Bros. & Co. xv
Ostrander & Co., W. R. xvii
Paiste, H. T. 282
Parker-Russell Mining and Manufacturing Co. xvii
Perkins Electric Switch Mfg. Co. xiv
Phœnix Glass Co. xiii
Phosphor-Bronze Smelting Co., Ltd xv
Pond Engineering Co. vi
Queen & Co., James W. xiii
Ridion & Co. xiii
Royce & Mareean. xvii
Santley & Co., W. R. xviii
Sawyer-Man Electric Co. xx
Schieren & Co., Chas. A. xiii
Schuyler Electric Co. xviii
Sessions Foundry Co. xx
Shaw & Co., J. Elliot. xiii
Shipman Engine Co. xxi
Shultz Belting Co. xvi
Sigourney Tool Co. xvi
Solar Carbon Mfg. Co. x
Southern Electrical Supply Co. xiv
Standard Electric Supply Co. xxii
Standard Paint Co. xiii
Stanley & Hall. xvi
Star Electric Co. xiii
Stephenson Co., John vii
Thomson-Houston Electric Co. v
Thomson-Houston Electric Light Co. ix
Tropical American Telephone Co. xiv
United Electric Traction Co. ix
Universal Arc Lamp Co. xviii
Vincent & Co., Charles R. vi
Walker Electric Co iv
Wanted, Position, Electrical xiii
Washburn & Moen Manufacturing Co. xvii
Watson & Stillman. xvi
Wenstrom Consolidated Dynamo and Motor Co. xiii
Western Electric Co. xvii
Westinghouse Electric and Mfg. Co. xvi
Weston Electrical Instrument Co. vii
Wheaton & Co., J. C. iii
Whipple Co., Fred H. xxi
Williams & Potter. vi
Woodhouse & Rawson x
Wyckoff, Seamans & Benedict 282

Benner, the Ohio prophet, predicts a good financial year for 1891. If this is so, the prophet will profit.

By far the greater number of rapid transit schemes presented to the New York Rapid Transit Commission favor electricity as the motive power.

We present this week a full account of the annual report of the Edison General Electric Company. The excellent results achieved are creditable both to the splendid management of the company's finances and the excellence of the products offered for sale. Such a report is the best kind of evidence of progress in the electrical field, and its publication at this time should reassure investors that confidence may be placed in electrical interests when competently managed.

Reports of the devastation caused by the recent storm continue to come in. In the vicinity of New Britain, Conn., icicles an inch in diameter and weighing two pounds to the foot, were taken from wrecked wires. Much new wire is now only fit for the junk heap. The loss in the storm area in Connecticut alone is estimated at $250,000.

Among technical men there can be little difference of opinion as to the entire suitability of an electric underground railway on the separate tunnel system to the needs of New York, and its great advantages over any other of the schemes proposed, elevated, arcade or viaduct. It is relatively economical and absolutely speedy in construction, property is not interfered with nor other traffic delayed while the work is going on, and once the line is in operation, safe and quick transportation is assured. New York has now the opportunity of constructing the grandest lay-out of city railroad ever dreamed of. The London line is at present the admiration of electrical engineers on both sides of the water. In a few years, if all goes well, the underground electric railroads of New York will be one of the great wonders of the world.

A curious incident, which points an interesting moral, is related in Mr. F. L. Pope's lecture on "Electric Railways," read before the Electric Club last week. Mr. Pope tells how when visiting an electro-plating factory at Ansonia he saw a workman place a metal pail on the two wires leading from a dynamo supplying current for plating. The pail instantly disappeared, being not merely melted, but converted into metallic vapor, which illuminated the whole workshop with a flash of startling radiancy. The impression which such an incident would have produced on an ordinary observer would be that the current was a very dangerous one, and that it would mean instant death to touch the wires. As a matter of fact, the two wires could be grasped one in each hand without experiencing the slightest unpleasant sensation, the heating effect which was so startlingly demonstrated being produced by the great volume of current flowing. There is no instance on record of any dangerous shock having been received from an electrical railway, which carries a current of considerable volume, but at a comparatively low difference of potential.

SEVERE STORM.

During the night of the 24th inst. a cold wave and a rain cloud collided in the atmospherical vicinity of Manhattan Island. The result was a heavy fall of wet snow which stuck to everything. An immense number of overhead wires were broken by the accumulation of snow and icicles upon them. Electric light, telephone and telegraph circuits were rendered inoperative, and many poles were borne down under the unusual strain. One wire to Buffalo and two Atlantic cables were all the news carriers available after the storm had done its work.

MR. POPE'S ABLE LECTURE.

Mr. F. L. Pope's lecture to the New York Electric Club upon "The Electric Railway," published in full in this issue of the ELECTRICAL REVIEW, is brimful of interesting matter. The lecturer deserves the gratitude of all Americans for rescuing from oblivion several important historical relics relating to the origin of the electric motor and its use in locomotion, invented by Thomas Davenport, "a Green Mountain village blacksmith," an humble Vermont mechanic, whose genius anticipated and utilized the shunt wound motor principle long before the light dawned upon the scientific world. The history of the electric railway is a story of American achievement from beginning to end—whether by overhead, underground or battery supply of energy. The statistics quoted by Mr. Pope are convincing that electric locomotion has come to stay, both by reason of economy of operation and safety to the public. His remarks upon the insignificant number of fatal accidents attributable to electrical causes, show the absurdity of the public prejudice against electric railroad or lighting plants on this account. We commend the paper to the readers of the REVIEW for careful perusal, feeling assured it will afford them a degree of gratification as great as the enthusiasm inspired by its presentation at the Electric Club.

RAPID TRANSIT FOR NEW YORK.

Several causes have produced the recent agitation of the rapid transit question which New York is now experiencing. The Brooklyn bridge discussion, the overcrowded condition of the ferries, the acknowledged inadequacy of the elevated roads, and the success of the London and Southwark underground electric railway, may be enumerated as among the reasons for the interest lately evinced in this very important subject. Schemes without number have been proposed.

Among the latest plans, and one which looks as if business were meant, is the scheme of Mr. Austin Corbin to construct tunnels connecting together Brooklyn, Jersey City, New York, and the annexed district. Express and way trains, operated by electricity, are to be run through these tunnels.

It is evident that the conditions of the problem preclude any other form of transit than an underground railway under the two rivers and the down-town district of New York. It is also true that no other motive power than electricity is practicable owing to the increase in cost of construction, were it necessary to ventilate the tunnels, as would be the case were steam power employed.

But it seems to us that the cost of the whole system could be materially reduced and the benefits of rapid transit extended over a much larger area, were surface electric roads used in the outlying and more thinly populated districts, to bring passengers to the tunnel termini.

The whole question at present, however, is naturally in an embryonic state; when a definite scheme has been decided upon and proper and adequate financial support secured, the requisite electrical engineering talent will be forthcoming, and it will be but a question of time to complete and perfect the system.

It is encouraging to note the unanimity of opinion that electricity in one form or another is the only motive power in sight for the purpose. In this instance the lay and technical press agree on matters electrical. There is ample prospect of profit to any company which will provide comfortable rapid transit, no matter what the outlay required.

Let us hope it will fall to the part of electricity to give New York and vicinity the boon so much to be desired, and that proper facilities may be afforded to the great metropolitan public for sitting down while in transit between home and office, a habit of which this same public has been most thoroughly broken by years of submission to inconveniences which only an American would tolerate.

BOOK NOTICES.

The second installment of the "Tallyrand Memoirs," to be published in the February *Century*, will be devoted entirely to Tallyrand's narration of his personal relations with Napoleon Bonaparte. The frontispiece of this number of the *Century* will be a portrait of Tallyrand engraved from a painting by Greuze, in possession of M. Chaix D'Estange. Here are a few maxims of Tallyrand, compiled by the St. Louis *Republic* from the papers of M. Colmache, private secretary to the prince:

What I have been taught I have forgotten; what I know I have guessed.

Both erudition and agriculture ought to be encouraged by government; wit and manufactures will come of themselves.

There are two things to which we never grow accustomed—the ravages of time and the injustice of our fellowmen.

To succeed in the world it is much more necessary to possess the penetration to discover who is a fool than to discover who is a clever man.

"Abstract of the Proceedings of the Society of Arts," for 1889–1890, has been received.

Discovery is the name of a new English monthly devoted to invention, scientific discovery, and the application of science to industrial purposes. The number for the current month is "Vol. 1., No. 1," and is a harbinger of better things.

"Bulletin de la Societé Internationale des Électriciens," for December, 1890, has been received.

CORRESPONDENCE.

OUR BOSTON LETTER.

Mr. David Chalmers, of the electrical supply house of Messrs. Alexander, Barney & Chapin, is on a business visit to this city.

Mr. James G. Biddle, representing Messrs. Queen & Company, Philadelphia, was in this city recently, and favored this office with a visit.

Boston Electric Club.—On Thursday evening, January 29th, a paper will be read by Mr. Frank M. Gilley, subject: "Electrical Bohemia." An intellectual treat will certainly be afforded by Mr. Gilley's paper. Every member should be present.

The Eastern Electric Cable Company, of this city, has two separate gangs of men at work, a day and night force, thus ensuring the prompt filling of rapidly increasing orders. The company recently purchased a large piece of land adjoining its present property, and contemplate erecting an additional factory in the Spring.

The Berlin Iron Bridge Company, well known as builders of fire-proof electric light stations, has been awarded the contract to build an iron bridge across the Quinnipiac River, at Plantsville, Conn.

The Mather Electric Company, Manchester, Conn., has declared a quarterly dividend of one per cent. Business was never better with the company, its factory facilities being pushed to full capacity.

Another Electric Railway will soon be built between the towns of Spencer and Leicester, Mass.

Secretary E. I. Garfield, of the Thomson-Houston Electric Company, has returned from a business trip among his company's varied interests in the West.

Captain Eugene Griffin has been elected second vice president of the Thomson-Houston Electric Company. Mr. O. T. Crosby becomes general manager of the company's railway department to succeed Capt. Griffin.

The Standard Electric Supply Company, of this city, has introduced a novelty in waterproof lamp sockets for incandescent lighting in mills and manufacturing establishments. This company is daily in receipt of orders for its new ammeter and voltmeter, one order alone for 20 of these reliable instruments from the large house of Messrs. Brown, Durell & Company, of this city. W. I. B.

Boston, January 24th.

OUR CHICAGO LETTER.

Among the Many Strong Endorsements of Habirshaw wire received by the Electrical Supply Company, of Chicago, is the following from Walker & Keppler, of Philadelphia, Pa., which reads thus: "We have been using your white core wire almost exclusively during the last year for our incandescent work. In this time we have wired the Drexel Building, 2,600 lights; Keystone Bank, 400 lights; Catholic High School, 600 lights, and a large number of other buildings; total number of lights probably 10,000 to 12,000, and we are pleased to say that we never have experienced the least trouble with the insulation, which we consider A 1."

The Belding Manufacturing Company met with a serious loss by fire at their new factory at Hermosa on the evening of January 20th. The fire originated in an adjoining factory, and soon gained such headway as to become beyond control; spread to the Belding factory and completely gutted the buildings owned by this company. The loss on the building will amount to about $30,000, fully covered by insurance. The loss on machinery is about $5,000. This will be a total loss, as it was all new and had only recently been placed in position preparatory to starting some time this month. The building will be rebuilt at once. D. B. D.

Chicago, January 24th.

OUR ALBANY LETTER.

The New York State Legislature convened Monday, and held short daily sessions during the week.

The only business referring to electrical matters was the resolution offered by Mr. O'Connor, in reference to electrical executions, especially covering the Jugiro case. The resolution was referred to the judiciary committee, reciting that under recent decisions of the Supreme Court, the State laws are nullified in cases of appeals through *habeas corpus* to obtain discharges from imprisonment, and requesting New York's representatives, in Congress, to secure an amendment to chapter 353, United States statutes of 1885, to prevent infringement on the right of the State to regulate their domestic concerns.

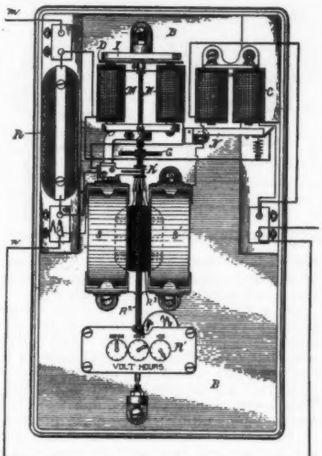
The Eickemeyer-Field Company, to do business in Yonkers, has been incorporated with a capital stock of $1,000,000, to manufacture and sell electrical railroad equipments. Trustees: Samuel Shethar, Rudolph Eickemeyer, Norton P. Otis, Stephen D. Field, Herbert F. Terrell, Edward A. Nichols and Prentice Shethar. L. M. W.

Albany, N. Y., January 24th.

PROGRESSIVE ELECTRICAL INVENTIONS.

CONSTANT CURRENT METER.

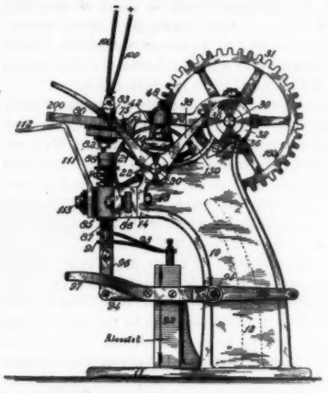
In the accompanying engraving is illustrated a meter designed by Elihu Thomson, of Swampscott, Mass., for the purpose of measuring the consumption of energy on arc lamp circuits. The meter is operated by an electric motor, the field magnets of which are placed in shunt to the group of arc lamps whose consumption of energy is to be measured, and the armature of which is placed in series with the lamps, but in shunt relation to a variable resistance, the armature shaft being provided with a retarding device such as a Faraday wheel. In the engraving, R represents an artificial resistance



in series, with a group of arc lamps L, current passing from the entering point *m* through the resistance wire *n*, group of lamps L, and out by the wire m^1. In shunt relation to the resistance is a loop, including the magnet M, controlling the retarding device and the armature of the motor; the shunt around the resistance passing first through the coils of magnet M and then through the armature, and then joining the main current at the lower side of the resistance R. The field-magnets S S^1 of the motor are excited by a shunt around the group of arc lamps, said shunt including the coils of a cut-out magnet C, which upon undue increase of resistance in the arc branch, actuates its armature *n* and closes a short circuit around the group of arc lamps. The armature of the motor is connected with a register upon which the number of volt hours may be recorded. At the other end of the armature is a metallic disk D, revolving in the field of the magnet M, and between the pole-pieces of said magnet and its armature I. When the arc lamps are in service the difference of potential between the terminals of the loop in which they are placed is felt by the shunt coil S S^1 of the motor, thus producing a field more or less dense for the armature of the motor. The resistance R is adjusted so as to give the requisite rate for registering the number of units on the dial equal to volt hours. If the number of lamps is increased the potential at the terminals of the loop is increased and the motor rotation is more rapid, resulting in a more rapid registration.

HEATING BLANKS FOR ELECTRIC FORGING.

We illustrate herewith an improvement in electric heaters designed for heating blanks preparatory to forging. The invention is due to Messrs. George C. Burton, of Boston, Mass., and Edwin E. Angell, of Somerville, Mass. The machine comprises a main shaft 20, driven by a pulley 21 and operating by means of the gear-wheel illustrated, a secondary shaft 30, upon which is mounted an eccentric for imparting a reciprocating horizontal and vertical motion to two levers, upon the front end of which are mounted insulated electrodes 80. These two electrodes are placed side by side, only one being seen in the drawing, and are connected by conductors 100 with a suitable source of current of sufficient volume to develop the necessary heat in the blank. The front end of the electrodes are recessed, as indicated by the dotted line, and in this recess is laid the blank to be heated. The movement of the machine causes the eccentric to throw the



two electrodes first apart, thus releasing their pressure upon the ends of the blank and developing sufficient heat to render the blank ready for the forging operation. A further movement of the eccentric then depresses the electrodes and permits the blank to slide off on the guide 112 to a point where it may be forged. The circuit may be controlled by means of the lever 97, controlling a resistance 92 in a shunt around the electrodes when the blank is being heated. There are several ingenious mechanical details permitting the adjustment of the rocking electrodes.

The Biggest Rapid Transit Scheme Yet Proposed.

The Metropolitan Underground Railway Company has filed articles of incorporation at Albany. It is not only proposed to connect New York and Brooklyn by tunnels, but both cities are to be connected with Jersey City, and New York is to be tunnelled on the east and west sides, from the Battery to Jerome Park. The plans include the building of 42 miles of tunnel at an estimated cost of $60,000,000.

The incorporators are: Austin Corbin, Secretary of the Navy B. F. Tracy, Gen. John Newton, U. S. A.; H. O. Armour, ex-Mayor Abram S. Hewitt, President E. Norton, of the Louisville and Nashville Railroad; President F. P. Olcott, of the Central Trust Company; President W. B. Dickerman, of the Stock Exchange; Vice-President Levi P. Morton, John Sloane, of W. & J. Sloane; President Charles Stewart Smith, of the Chamber of Commerce; Samuel Thomas, of the East Tennessee, Virginia and Georgia Railroad; Senator Calvin S. Brice, of Ohio; E. F. Knowlton, of William Knowlton & Sons; Vice-President Porter, of the Pullman Car Company; W. B. Kendall, treasurer of the Bigelow Carpet Company; President C. P. Huntington, of the Central and Southern Pacific Railroads; E. F. Winslow, recently President of the 'Frisco Railroad; President D. C. Corbin, of the Spokane and Northern Railroad; President J. Edward Simmons, of the Fourth National Bank; Lawyer Albert B. Boardman, Frederick S. Brown, of H. L. Horton & Company; Lawyer Edward Lauterbach and President Alexander E. Orr, of the Produce Exchange. The directors for the first year are: Messrs. Austin Corbin, Norton, Brown, Sloane, Porter, D. C. Corbin, Simmons, Lauterbach, Tracy, Knowlton, Kendall, Boardman and Dickerman.

The articles filed at Albany only include the boring of the tunnel between New York and Brooklyn; over $30,000 has already been spent in preliminary work.

Board of Electrical Control.

The Board held an extremely lively meeting January 23d. Permission was granted to the Harlem Bridge, Morrisania and Fordham Surface Street Railway to use the overhead electric system in place of horse power.

Mr. C. J. H. Woodbury, of Boston, passed through New York last week on his way to Philadelphia.

Prof. Tyndall, the eminent English scientist, who has been seriously ill, is reported to be improving.

The death is announced from Havana of Prof. Nicolas Gutierrez, the well-known Cuban scientist and president of the Academy of Sciences.

Exhibitors at Providence.

The following are the names of applicants for space at the Providence electric light meeting received up to January 20th:

Phœnix Glass Co., New York city, electric glass ware, globes, etc.

Washburn & Moen Mfg. Co., Worcester, Mass., samples of wire.

New York Insulated Wire Co., New York city, insulated wire and cables.

Electric Engineering and Supply Co., Syracuse, N. Y., electric lighting and railway supplies.

Swartz & Gannett, Providence, R. I., electric appliances, accumulators, phonographs, etc.

The Eddy Electric Motor Co., Windsor, Conn., motors and dynamos.

Jewell Belting Co., Hartford, Conn., belting.

American Electrical Works, Providence, R. I., insulated wire.

Jenney Electric Motor Co., Indianapolis, Ind., motors and switches.

Interior Conduit and Insulation Co., New York city, interior and underground conduit.

James W. Queen & Co., Philadelphia, Pa., electrical instruments.

Drake, Payson & Whittier, Providence, R. I., electric models, motors and specialties.

The Okonite Co., New York city, insulated wire, etc.

The E. S. Greeley & Co., New York city, electrical instruments and supplies.

Alexander, Barney & Chapin, New York city, general electric supplies.

H. T. Paiste, Philadelphia, Pa., switches, cut-outs, etc.

The Bryant Electric Co., Bridgeport, Conn., electric supplies.

Bernstein Electric Co., Boston, Mass., series lamps and instruments.

T. M. Foote Regulator Co., Boston, Mass., speed regulator.

The Holtzer-Cabot Electric Co., Boston, Mass., electric light appliances.

John Lynch, Washington, D. C., terra cotta conduits.

The C. McIntire Co., Newark, N. J., McIntire connectors, etc.

Eureka Tempered Copper Co., North East, Pa., copper brushes, commutators, etc.

Standard Electric Supply Co., Boston, Mass., voltmeters and ammeters.

Narragansett Electric Lighting Co., Providence, R. I., display of incandescent lamps, etc.

The Johns-Pratt Co., Hartford, Conn., vulcabeston insulation.

Shultz Belting Co., St. Louis, Mo., belting.

The Walker Electric Co., New York city, ammeters, voltmeters, etc.

Chas. A. Schieren & Co., New York city, belting.

Sperry Electric Light Co., Chicago, Ill., arc lamps, etc.

Thomson-Houston Electric Co., Boston, Mass., recording watt meters.

G. G. Stillman, Boston, Mass., Spencer damper regulator.

New York Gas Commission.

The Gas Commission met at the Mayor's office at noon, January 23.

The first bout was between Superintendent McCormack of the Bureau of Lamps and Gas of the Department of Public Works and Superintendent Moore of the North New York Electric Light Company, on the subject of the lighting of the annexed district. Superintendent Moore proposed to light this district with electricity at a less cost to the city than is imposed by the gas companies. He was prepared to construct and operate 271 arc lights in the annexed district, which would permit of the disuse of 1,672 gas lamps. The cost of the electric lighting would be at least $1,000 less than is charged for the gas lighting that would be discontinued. He said that in making this proposition he had first fortified himself with figures which made his statement proof against contradiction.

Mr. McCormack at once challenged Mr. Moore and said that the gentleman based his offer on guesses, while he was prepared with undisputed figures to show that no such saving could be secured by the substitution of electricity for gas. On the contrary, to substitute electric lighting for gas lamps would very materially increase the cost of lighting the streets.

Commissioner Gilroy, Mayor Grant and Comptroller Meyers then took the subject in hand. They scrutinized the list of streets which the North New York Company submitted, and selected these to be lighted by electricity: Southern Boulevard, 14 lamps; Third avenue, from Harlem Bridge to 177th street, 47 lamps; Alexandria avenue, 9 lamps; Lincoln avenue, 5 lamps; Willis avenue, 14 lamps; 138th street and Madison avenue bridge, 17 lamps.

Telephonic News

*** The New England Telephone and Telegraph Company will extend its lines at Waltham, Mass.

*** The new issue of the Bell Telephone stock will come in for the regular July dividend, and also for the extra.

*** On the 6th, 7th and 8th of January over 21,000 calls were answered at the Dayton, O., telephone exchange.

*** The Bangor & Portland Railway Company is having new telephone instruments put up at every station along the road.

*** The number of subscribers to the telephone exchange at Berlin, Germany, has increased 50 per cent. in less than two years.

*** The authorities of the Port of Bordeaux have decided to lay a telephone cable to enable vessels in the roadstead at Pavillac, 26 miles out, to communicate with the port.

*** Telephone companies generally report a prosperous year for 1890. The meetings of the various State legislatures at this season will, of course, bring a flood of bills attempting to reduce rentals.

*** The Erie Telegraph and Telephone Company sub-companies made a net gain of 30 subscribers in December; or 209 for the quarter ending December 31st. Total number connected, 13,117.

*** The question of what rates shall be charged for the use of telephones in Washington still continues to excite attention at the Capitol. There are two bills before the House District committee, both cutting the present telephone rates down about one-half. No action has been taken on these bills by the committee, and it is not thought that they have even been considered.

The Telephone in France.

According to the *Bulletin des Téléphones*, the number of subscribers to the nine chief telephone exchanges in France was at the end of November as follows: Paris, 9,200; Lyons, 800; Marseilles, 600; Bordeaux, 500; Lille, 450; Reims, 400; Roubaix, 350; Tourcoing, 500; Nancy, 176. Cannes, Saint Etienne, Nantes, Troyes, Saint-Quentin have about 150, and then some 30 towns with from 50 to 100 subscribers each.

The Resistance of the Atmosphere.

Experiments on the French railways show that the resistance of the atmosphere to the motion of high speed trains amounts often to half the total resistance. Two engines, of which the resistance was measured separately and found to be 19.8 pounds per ton at 37 miles per hour, were coupled together and again tried. The resistance fell to 14.3 pounds per ton. The second engine was masked by the first. It may be argued from this that by a suitable adaptation of the front of a locomotive, electrical or otherwise, a saving of from 8 to 10 per cent. of the effective power could be made.

The London-Paris Telephone.

An additional 25 miles will complete the English land wires, which have already advanced as far as Ashford on the road from London to Dover, says our London namesake. The work is being performed by men belonging to the telegraph battalion of the Royal Engineers, who number altogether about 60, and proceed, in gangs, at different points on the route. The route which the cable is to take under the Straits of Dover has been decided on, but the cable has yet to be laid. It is expected that communication will be open by the end of January. There are four wires (erected on the twist principle), the object being to permit two persons to speak simultaneously, either at the Bourse in Paris, or at the Royal exchange in London, at which places the instruments are to be fixed. At night, when the exchanges are closed, the wires will, if necessary, be used for telegraphic purposes.

"Modern Uses of Electricity."

ADDRESS DELIVERED BY DR. MOSES G. PARKER, BEFORE THE Y. M. C. A., AT LOWELL, MASS., JAN. 7TH, 1891.

Mr. President, Ladies and Gentlemen of the Y. M. C. A.:

I have been asked to speak to you this evening on the modern uses of electricity. The number being almost unlimited, I shall refer only to a few of the more recent applications to which it has been made.

Before entering directly upon our subject, it may be well to hastily review the history of electricity, the laws governing which are gradually being revealed, so that this, the greatest and most powerful, quickest and altogether the most useful of all known forces, is in daily use, with an adaptability seemingly without limit.

Historically, we learn that Thales, 600 B. C., refers in his writings to the fact that amber when rubbed attracts light or dry bodies, and this seems to be the only electric fact known to the Ancients; and yet one can hardly doubt that many of the Ancients petted and stroked their cats, long before this; and some may have seen the sparks that we often observe, on a cold night, while rubbing this familiar pet.

The science of electricity properly begins about 1600 A.D., when Gilbert, of Colchester, published a list of substances which he found to possess the same property as amber, and speculates on magnetic and electric forces. He invented the word electricity, which he derived from the Greek word electron—amber.

Otto Von Guericke, in 1672, invented the first electric machine ever made. It consisted of a globe of sulphur turned by a handle and rubbed by a cloth pressed against it by the hand.

Grey and Wehler, in 1729, first transmitted electricity from one point to another and distinguished conducting from non-conducting bodies.

Dufay was the first to discover two kinds of electricity and Muschenbrock, in 1746, discovered by accident the Leyden jar, since so useful in science.

Franklin, in 1752, proved the identity of lightning and electricity by his famous kite experiment, and when he communicated to the Royal Society of Great Britain the report of his experiment, showing the identity of lightning with other electrical phenomena, the report was greeted with a shout of laughter. It was a too literal interpretation of Bacon's great words, "to ask science to learn new truths by playing with paper kites."

Galvani, in 1780, discovered by accident that the limbs of a recently killed frog, when hung by the crural nerve on a metal support near an electrical machine, contracted convulsively at the re-currence of each spark. From this he discovered Galvanism, which will always connect his name with one of the most familiar forms of this stupendous force, and yet he was so ill-treated that he wrote: "I am attacked by two very opposite sects—the scientists and the know-nothings. Both laugh at me, calling me 'The frogs' dancing-master;' yet, I know that I have discovered one of the greatest forces of nature."

On Christmas morning, 1821, Faraday showed to his young wife the first revolving machine ever constructed and run by electricity. It was a vessel filled with mercury; a bar magnet floated on this liquid, being tied to the bottom of the vessel by a string; a copper wire was supported in a vertical position so as to dip into the mercury; one pole of the battery was connected with the mercury, and whenever the other pole of the battery touched the copper wire, the floating magnet would revolve around the wire. This was really the first electric motor.

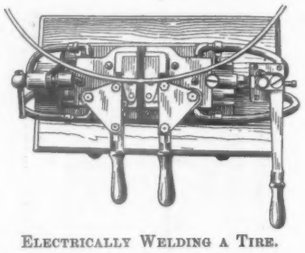
Ampere was the first to magnetize a common sewing-needle by causing an electric current to pass through a wire wound around the needle.

Barlow, in 1826, followed with the electric spur-wheel, *i. e.*, a spur-wheel revolving between two magnets. This was then a popular toy, but originally made to illustrate Faraday's discovery. This same year Sturgeon invented the electro-magnet.

Henry, in 1830, devised and constructed the first electro-magnetic motor, and in 1831 wrote to Professor Stillman: "I have lately succeeded in producing motion by a little machine which I believe has never before been applied in mechanics—by magnetic attraction and repulsion." This same year he constructed a telegraph in which strokes upon a bell were produced at a distance, and this contained all the fundamental and necessary mechanism of the electric telegraph of to-day.

Morse, in October, 1832, had his attention first called to the subject of telegraphing and used the bows made by the electro-magnet (as Professor Henry had done before); these he recorded on paper. The result was the Morse alphabet. It is said Mr. Morse was much chagrined to learn that the operators becoming skillful soon read messages by sound, as they do now, without the aid of his dots and dashes. From 1844 to 1872 no important advance was made in telegraphy. This year (1872) the duplex system, invented in 1853, by Gintl, was reduced to a practical form by Stearns, of Boston, and two messages were sent at the same time on a single wire; one out and the other back, simultaneously. After this came the quadruplex telegraph, which sends four messages simultaneously on a single wire; two out and two returning. This method is in common use to-day.

Other methods, viz. the synchronous-multiple telegraph, the electro-chemical telegraph, the multiple-harmonic telegraph and the various automatic telegraphs, all



ELECTRICALLY WELDING A TIRE.

invented to increase the capacity of one wire, which is to-day, by the Morse instruments, not above 75 words per minute.

The advocates of some of these new instruments have claimed that as many as 4,000 words per minute may be sent over a single wire, but considering the signal failures in sending 1,000 words per minute, we conclude that it is not yet reduced to practice. That some automatic telegraph of great capacity will ultimately be made practical there can be but little doubt. Then, and not till then, can we expect the cheap postal telegraph, so much desired.

Telegraphing from cars in motion is done by induction. The outfit consists of a telegraph key, a battery and a telephone placed in circuit; one wire being attached to the tin roof of the car, the other is passed out of the window or through the floor and attached to some part of the iron connecting with the wheel. The messages are sent by the Morse key, but are read by aid of the telephone in the car and at the station. The telephone, the most delicate of all electrical instruments, here comes to the assistance of the telegraph, and makes it possible to communicate not only with cars in motion, but from high points of land at considerable distance apart without a connecting wire, and from boats on the Hudson River. These are some of the wonderful electrical achievements made by combining the telegraph and telephone. The latter instrument you are all so familiar with I shall leave its possibilities to your imagination rather than detain you here by a recital of its freaks and novelties.

Simple as it is to locate breaks in the wires miles away or the cable breaks in mid-ocean, so that we may sail directly to the place of rupture, it is not generally understood, and a description may not be uninteresting here. Buckingham, of the Western Union, says: "If the metallic conductor were broken, the surrounding insulation remaining perfect, the electrostatic charge of the cable or the amount of electricity which it absorbs in becoming charged, is electrically weighed by building up an artificial line until the current flows equally into the cable and such artificial line. If the currents are equal, the armature of the differential instrument remains quiescent during their passage through the coils, for one balances the other. Each element of the artificial line having the static capacity of a known length of cable, an inventory of the elements used in making the artificial line would obviously give the length of cable. This process is no more abstruse than would be the determination of the distance of a water-tight obstruction in a pipe, by forcing in or pumping out water and taking its measurement. If it were known that a pint of water filled a foot of the pipe, the length of the conduit would equal, in feet, the number of pints pumped out or forced in."

In 1873, Faraday published the first of his researches on induction and produced the first experimental machine for the mechanical production of electrical currents. In his researches he disclosed the principles that made telegraphing, telephoning, electric lighting and transmitting of power, possible. Within a year after Faraday's experiments were published, a Frenchman had constructed an instrument, in which a permanent magnet was made to induce currents in the wire surrounding an electro-magnet; this, improved by Saxton, of Philadelphia, was the well-known "electric shock machine" turned by a crank; really an infant dynamo.

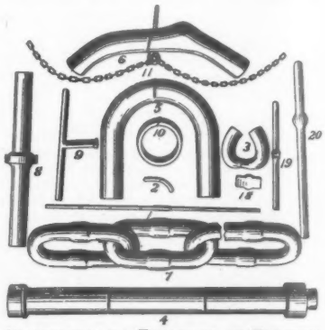
Gramme improved this and made the Gramme dynamo which he exhibited at the World's Fair at Vienna, in 1873. He had one set up and running. Wishing to show their varied application, he ordered others set up, when a lucky mistake happened, it was this: While connecting up these machines after one had been set running the wires became crossed so that a wrong connection was made, when, instantly, greatly to the surprise of all, this second machine commenced revolving rapidly in the wrong direction. Gramme seeing this, saw the first practical electric motor and instantly the idea of transmitting power over a wire was born; from that time the realization of this idea has been beyond our wildest imagination.

When we remember that electricity, according to Wheatstone, has a discharging velocity of 288,000 miles per second, greater than light, which travels only 195,000 miles per second; that its induced current must be indefinitely great, we no longer wonder that the rapidly revolving little wheel, to which this current is applied, runs away so easily with the big one and the great load attached thereto.

I shall not attempt to describe the different applications of the electric motor, for the reason that up to January, 1889, Mr. C. J. H. Woodbury had recorded its applications in 140 different industries, requiring motors varying in power from only the fractional part of one horse-power to motors for the heaviest kind of machinery using thousands of horse-power (the largest is near London, England, with 5,000 horse-power capacity).

It would be impossible to speak of all the modern uses of electricity in one evening. So far has this wonderful agent become a demand, that gas, water and steam are replaced by it, and in many instances it is available where these could not be used.

I must pass rapidly over the thousand and one ingenious applications of electricity; such as, electric door latches, electric door knobs, electric mats, electric clocks, improved magneto bells, striking with great force; the increase of power is obtained by the crossing of the electric current; electric



COLLECTION OF EXAMPLES OF ELECTRIC WELDING.

watchman's call giving the honest watchers of the night assistance at short notice, electric range finder for the cannon's proper elevation, electric adding machines, electric sound registers, electric bleaching machines, electric mining machines, etc., till we come to one of the latest inventions which from its novelty deserves mention. It is the electric incubator of L. E. Ross, in which the incubator is heated by a kerosene lamp, the temperature is controlled by a thermostat made by a compound bar of hard rubber and steel, and whose operation actuates a slight register which permits the escape of the heat if the temperature rises above a predetermined point.

Another of great interest is the electrical statistical machine, a very small machine, being scarcely larger than a typewriter, which is able to record and separately add three hundred different classes of facts. It is used by the New York Board of Health; was used in making the last census returns in this country, and is to be used on the census returns of Russia, Germany, Italy and, probably, Great Britain.

In surgery and medicine electricity is of great value, enabling the surgeon to do some operations without losing blood or leaving scars. In medicine it is used as a remedy and a means of diagnosis; for example, in some cases of palsy the cause may be located in the nerves or in the brain; electricity enables the physician to determine which, and often locates the disease. Its action is intensely interesting; when applied to the eyes one sees colors; applied to the ears, one hears sounds; the same with taste and smell; again, if applied to certain parts of the brain, one is made to see colors, hear sounds, taste and smell, showing that different parts of the brain are separate and independent in their action with separate and independent functions.

LIGHT AND COLOR.

The application of electricity in producing light and color is most brilliant and

pleasing. All of us have seen most brilliant displays of light and color when electric light is thrown on fountains. This is done by placing a reflector behind and colored glass in front of the electric light. You see at once that the variety of color is only limited by the ability of glass to retain color; for example, you may use electricity to force the water in columns, using an electric light on the side, or better, under the column of water, and with a reflector to throw the light and colored glass to vary the color, you will produce one of the most attractive fountains imaginable, whose columns of water may reflect all the hues of the rainbow.

Since the invention of the incandescent light the glass covering to the light has been made in various forms and colors to imitate flowers and other beautiful designs, so that now, at our theatres and operas, it is not uncommon to see the flowers bloom and fade at will, adding great brilliancy to the scene. Carrying this idea still further, it is not only possible but practical to arrange many thousands of these lights, covered with glass of all the colors it seemed capable of retaining, grouped and so arranged that they can all revolve, or part revolve, while the rest remain stationary. The electric current being let into those lights by means of keys and pedals, in like manner as the air is let into our musical organ, so that all the variety of form and color, from the delicate flower to the variegated and many angled star, with the rainbow and all the varying forms and colors of the kaleidoscope, are easily produced by the operator at the keyboard; in short, here is an organ of color and form revolving or stationary, wholly under the control of the artist and capable of charming the eye as the ear has been charmed by music.

Through the kindness of the Thomson Electric Welding Company and Lieut. W. M. Wood, U. S. A., who has charge of the making of projectiles by the electric welding process, I am able to show you samples not only from his department, which are exceedingly interesting, but from other departments, showing the general application and wide range to which this new and one of the greatest inventions of the age is applicable.

The first sample shows copper welded to brass, brass to iron, iron to steel, steel to German silver, etc., demonstrating at once that the electric welding process will weld metals that it is impossible to weld by any other means.

No. 2 is a sample of aluminum welded, a metal most difficult to weld; the union seems perfect. By this process the welding of different metals to each other is only limited by their varying welding temperatures, *i. e.*, if the welding temperature of one is not above the melting temperature of the other, they can be united.

No. 3 is a sample of lead pipe united; you notice that I hesitate to say, welded, because it never before was thought possible. It is, however, quite possible to coax brass pipe to weld to iron pipe, as seen in No. 4. I say, coax, because a little manipulation is required in the management of the machine to weld this, the point of union must not be in the center, as is the case in the welding of two pieces of the same metal, but must be placed so that less of the iron and more of the brass appears in the field; by this you concentrate the heat on the short piece of iron and distribute it on the long piece of brass; this is called coaxing.

Nos. 5 and 6 are pieces of iron tube welded so strong they break anywhere but in the weld and yet it is not much reinforced; the reinforcement is seen in No. 7 more plainly; here the links of the chain are reinforced to make them stronger and they break outside of the weld, as seen here.

No. 8. Sample of upsetting finished on one side.

No. 9. Spoke welded to tire; tires are spliced and welded, the last weld being the same as in the ring.

No. 10. There has been much discussion about the last ring weld. Why should the current pass across this ununited part of the ring and weld it, rather than follow the continuous iron? I shall not attempt to explain this or recall all the witty sayings about it, but Daniel Webster's explanation of the wheel is so applicable, I will give it. It occurred in Boston, years ago, during a litigation in a wheel case. Rufus Choate was counsel for one side and Daniel Webster for the other.

Mr. Choate, in his argument, wrought himself into a fury to show that the wheel could not be made in that way; that it was impossible to make it, and that the whole thing was a fabrication; and after he had very brilliantly stated his points, Mr. Webster, showing the wheel, merely said: "Your Honor and gentlemen of the jury, here is the wheel;" so we say, here is the ring.

No. 11. Sample of chain made by the automatic welding machine. It is unique, being simple, graceful and uniform (many a watch-chain has been taken from it). The automatic welding machine that makes about a foot a minute is not larger than a sewing-machine, and nearly as interesting.

No. 12. A government armor-piercing shell.

Nos. 13, 14, 15, 16. Armor-piercing shells made by the Thomson electric welding process; 13, unfinished; 14, finished; 15 has been fired through a three-inch iron plate, and, as you see, is hardly scratched; good for another trial. No. 15 penetrated five inches of steel armor and was thrown back about 80 feet; is also uninjured.

I have here a few other specimens. They are relics of the late war, and may be interesting to you by comparison; but to me, from vivid recollections. This one, a 12-lb. Witworth bolt fired from a rebel battery while we were in front of Petersburg, 1864, came about three miles and destroyed my dinner.

I shall now have thrown upon the screen photographs of different welding machines and a few examples of electricity as found in its natural state.

(The lecture was illustrated by 24 transparencies thrown upon the screen, from which we have selected our illustrations.)

ANOTHER VIEW OF NATURAL ELECTRICITY.

Ball Engines to be Made in the East.

There seems to be a prospect that the well-known Ball engine, many of which are doing such good service in the East, will shortly be manufactured by a new company organized for that purpose in the vicinity of New York. We understand that a number of New York gentlemen have made arrangements with Mr. F. H. Ball, of Erie, Pa., the inventor of the engine, and having bought his patents, Mr. Ball will sever his connection with the Ball Engine Company, of Erie, and shortly take up his residence in the East, where he already has many friends among our leading mechanical engineers.

ELECTRICITY IN ITS NATURAL STATE.—(SEE DR. PARKER'S ADDRESS.)

It is expected that the new company will be incorporated with ample capital, and that new shops will be erected possessing all recent mechanical improvements. The Ball Engine Company, of Erie, will continue at present to manufacture the engine under Mr. Ball's shop rights, and with Mr. James McBrier as president, whose large lumber and other interests in the West have made his name familiar to business men in that section. The relations between the Erie and New York companies will be very cordial and intimate, since the latter will be largely interested in the stock of the former.

Prominently associated with Mr. Ball will be Mr. Thos. C. Wood, who for many years has been connected with the engine interests both in Erie, Pa., and in New York.

The new enterprise is the result of the increase in demand for the Ball engine, Mr. Ball's system of governing having proved so successful, and the Ball engine so reliable, especially for the electric light and street railway interests, that it is safe to assume for the new company a large and profitable business from the start.

A Novel Velocipede.

La Lumière Electrique, in a recent issue, described the employment in military telephony of a tricycle, adapted either for traveling on roads or for use as a water velocipede, without the necessity of undergoing any change in its mechanical construction. The wheels, instead of the usual pattern, are formed of three large hollow bi-convex disks of sheet iron, and thoroughly watertight. They are fitted with small copper floats, which, while not in the way for road work, act as paddles when the machine is afloat. The hollow wheels serve to support the construction on water. A small drum is carried, on which is coiled from 100 to 200 yards of a tinned copper conductor, insulated with gutta-percha and double braided. A small board, conveniently fixed, carries a portable telephone or a Morse sounder. The telephone is preferable, as it can be carried in the pocket, requires no regulation, and can be attached to the chin-strap of the helmet or other military head-gear. For river or lake work one Leclanché cell is used, but on salt water the following type of cell is employed: Two small electric light carbons, connected metallically, are secured in grooves cut in the opposite faces of two pieces of cork. Between the carbons, and through the center of the cork, a thin rod of zinc is passed, and to it is attached, by a wire, a copper plate. The carbons are connected to the instrument board. When required for work the cell is placed in the water. The speed attained with this tricycle has been on land from 9½ to 12½ miles, and on water from 2½ to 4½ miles per hour. It is said to work very easily, and experiments with it, recently conducted at Marseilles, are reported to have resulted very satisfactorily. Its employment is described as likely to be of service to detached bodies of troops carrying with them no pontoons, possessing no means of fixing up a temporary bridge, and engaged on duties which render necessary permanent communications with headquarters.

Electricity in Wine Making.

During the past eight months a process of increasing the "keeping" qualities of wine by electric treatment has been tested in France. The wine is passed through a small tube containing a series of silver disks connected to the pole of a 25 volt alternating machine having a frequency of 116. The virtue of the current is supposed to be due to the destruction of the ferments. The process is said to be a great success.

TELEGRAPHIC

.... A bill requiring telegraph companies to keep their offices open at all hours in towns of more than 5,000 inhabitants has been introduced in the Missouri House.

.... The Western Union has put on another girl messenger, and both have donned pretty and attractive uniforms, with the general characteristics of the uniform prescribed by the company.—*Colorado Springs Gazette.*

Old Bogy, the Tramp Operator.

[From the Oakland *Tribune.*]

He looked like a very ordinary man as he stood in the doorway of the train despatcher's office at the pier on Tuesday evening. He was dressed in an ordinary suit of clothes. His rather thin face was framed in a thin, reddish beard, through which peeped a pair of blue eyes. Taking it all in all, he was a very ordinary-looking man, and yet that man was the most noted telegraph operator in the United States, and possibly in the world. It was "Old Bogy."

Everybody who is or pretends to be a telegraph operator or a train despatcher knows Old Bogy. Wherever there runs a line by telegraph wire there is known that name, and it is pretty safe to say that Old Bogy himself has been pretty nearly wherever the telegraph has gone. Old Bogy's other name is Bogardus.

Twenty-five years ago, Old Bogy—for Old Bogy he was even when he was a lad—was a telegraph operator in the employ of the United States government. Bogy was a telegraph operator in the Capitol at Washington, and he handled all the important messages that came there from the front. He was trusted, and the confidence was not abused.

After a while he was sent to the front, and was in the midst of the fighting with Gen. Grant, and he played no unimportant part in the great strife. He was an expert operator—a better does not exist—and he held many a great secret during those troublous times.

After the war Old Bogy began to drift. He wandered from railroad to railroad, and from telegraph office to telegraph office, from one end of the country to the other, and before long the name of Old Bogy became a proverb among telegraph men. He had gained the bad habit of unrest that had fastened itself upon him during the war, and before long he became the most noted tramp operator in the United States. He seemed to have lost all desire or ability for steady work, and while his ability was of the highest, he would work a few weeks and then suddenly leave, and do nothing until his money was exhausted.

And so he traveled, working a little, borrowing a great deal, and often getting passes from point to point on railroad lines.

Train Despatcher Comstock, now at Oakland pier, worked with Old Bogy in Chattanooga, some seven or eight years ago. Bogardus had just been sent to China to put in operation a system of train despatching on the first railroad telegraph in that country. He was gone four years, and when he returned he was given a big reception at Chattanooga, and that was the beginning of his second downfall.

Five years or so ago Old Bogy drifted out to San Francisco and was employed in the Western Union office in that city. He worked there for several weeks, and just before pay day he went out of the office and never returned to get the money that was due him.

Old Bogy's uncle died in Rochester, N. Y., not long ago and left him $20,000, but so invested that he could draw only the income, and consequently the tramp operator is in better financial condition than ever before. He is good natured and good hearted in the extreme, and will share his last penny with his friends, but he is an inveterate borrower and the boys all like him, and he has no trouble making his way wherever he goes, traveling mostly on his reputation.

* * New Albany, Ind., is talking electric railways. A syndicate wants to build.

* * The speed of electric cars in San Antonio, Texas, is limited to 10 miles an hour.

* * A protest against the electric line at Newport has been made by a number of the wealthy Summer residents.

* * The rumor that the Tacoma, Wash., Railway & Motor Company had been sold to Phil. Armour, the Chicago pork packer, is denied.

* * A syndicate has been formed at Mount Holly, N. J., to purchase several farms in the vicinity of the town and lay them out in building lots. An electric street railway will also be built.

* * An electrical railway is proposed between Vienna and Buda-Pesth. A speed of 100 kilometres per hour is to be attained, and the distance is to be traversed in about three hours.

* * Buffalo is getting a good object lesson in these days as to the effect of the snow on the electric street car service. The new trolley line on Main street at Highland Park works to perfection, even with considerable snow on the track, and seems to prove that this ground of objection to the system is not well taken.—*Buffalo Express.*

* * During the week ending January 14 the contracts for electric street railway equipments of the Westinghouse Company alone were in excess of $250,000, and the company has now sufficient work under contract to keep the shops in full operation until Spring. The outlook is equally promising in the alternating current arc and incandescent work.

* * The new electric light plant being constructed near Overland Park, South Denver, is to be one of the best in the country. The company interested claim that neither pains nor means will be spared to give the people of South Denver a thorough service. It is reported that on the perfection of the light power the company will ask the town for franchises for car lines, which they expect to build.

* * At a meeting of citizens last week in East Orange, N. J., it was resolved to organize the East Orange Protective Association. The chairman made a strong speech denouncing the Township Committee for giving away the electric franchise with no adequate return. He charged that the Township Committee had descended to the level of the New York Board of Aldermen and had stultified itself in advocating rapid transit and then limiting the speed of the electric cars to eight miles an hour.

Description of the Ongley Electric Register and Safety Signal System.

Although new to the public in general, this system has engaged for the past five years the energy and skill of able mechanics and electricians, in order to so perfect it that, when introduced, it would at once take front rank among watchmen's clocks and protection systems. It effectually executes what has heretofore been merely attempted.

The necessity for an efficient system of automatic safety signals for use in factories, warehouses and other places has led to many inventions for the purpose. A system, to be complete, should provide means by which any neglects of the night watchman in the performance of his duties could be recorded in print. It should provide means by which an alarm could be promptly sounded in case of fire, and, in establishments where machinery is used, to enable the engine to be immediately stopped, in case of an accident, from any distant point, independent of the engineer. This system was seen in operation at No. 1 Broadway, this city, by a REVIEW representative, and worked admirably.

The register prints upon a strip of paper, one inch wide, the time at which a watchman on his rounds reaches any particular station, noting as well the number of such station. Example: If the station be No. 26 and the hour 9.50, on the strip will appear 29506 (see Fig. 2), the locality or order of signaling being immaterial.

An important fact is, that if for some very unlikely cause, the clock movement (which is of finest workmanship) should stop, be damaged or in any way affected, this will not entirely prevent the registration. In such case only the time would be omitted,

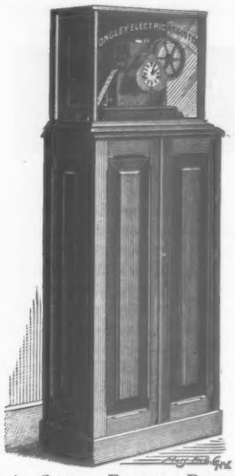


FIG. 1.—ONGLEY ELECTRIC REGISTER.

the numbers of stations visited being printed as usual. From these registrations it could be at once discovered if the watchman had failed in his duty. This is a most valuable quality, and one possessed by this system alone. The register can be used without special arrangement for from one to 90 stations, and any number of watchmen may record upon the same register without conflicting. Any meddling or trifling with the working of the system can be at once detected by the reading on the paper strip. The register instantly prints the number of stations where such tampering occurs. The apparatus contains really two instruments in one, of which either alone does more than

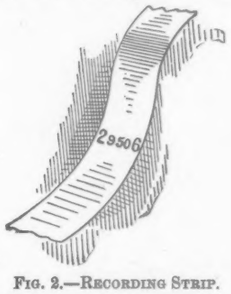


FIG. 2.—RECORDING STRIP.

any other device for the purpose; but when all its parts are working in unison it then achieves a most wonderful and accurate result, printing, as it does, in clear and distinct figures the station, the hour and the minute at which the signal is made.

Sometimes, in addition to the rounds required of a watchman at night, there exists places where there is liability to conflagration or danger to employés from machinery by day. Sometimes machinery in swift motion becomes disarranged, causing serious damage; rapidly revolving wheels may break, belts may catch, etc. It may be desirable for these reasons to be able to instantly stop the engine from various places in a building. At such localities are placed stations, which are small iron dust-proof boxes from which project handles. When at rest these handles are at 0, but they may be readily turned to numbers 1, 2, 3 and 4. Should it be needful at any time to stop the engine from any of these stations, however distant, it is only necessary to place the handle over the fig. 4, and then release it. Before the handle will have returned to its normal position—about 10 seconds—the engine with all attached machinery will have quickly and silently stopped, independently of any action on the part of the engineer, and more smoothly than if the engineer were standing with his hand on the throttle at the instant the signal was given. This part of the system is accomplished by a simple electric hydraulic valve placed at any distance desired from the engine, being piped to a cylinder connected with the throttle valve, and which does not interfere with the engine's usual working, whatever its size or style.

This electric valve is automatic in its action, requires no re-setting when its work is accomplished, and can be instantly and repeatedly used as may be required. It works with water pressure taken from house tank, main or other supply, steam pressure being substituted if desired. At the same time the engine is stopped a special instrument (called a recorder) indicates the number of the station in the two lower squares; also in the upper square the number of times it is repeated. At the same time an alarm bell is set ringing, and continues to ring until the engineer or other person in charge replaces the numbers to zero by the use of the handle at the base of the recorder. In this way no mistake can be made, as by the use of the old style of single stroke bell. This is repeated four times, while the register in the office prints the number of station, the hour and the minute four distinct times. The figs. 1 and 2 are used to signal to the engineer to start his engine, thus: "1," start slow; "2," full speed.

FIG. 3.—STATION APPARATUS.

The fig. 1 is used at night by the watchman to register his movements. The fig. 3 is to be used either by night or day for fire or burglar alarm, or for one watchman to call a comrade or patrolman to his assistance from a distance.

If by day fig. 3 is used for fire alarm, and there be a lack of water pressure in the building, so that a steam pump is required, an extra valve may be arranged so that when the handle is placed at fig. 3, and at the same moment a button is pressed in the bottom of the box, the steam pump will start and the gong in the engine-room will repeat the number of stations three times, all of which will be as usual recorded by the register.

When the handle is placed on fig. 3 at night for the above causes, a continuous automatic signal begins which cannot be stopped by the person giving it, and which allows him to leave the station for any purpose, while continuing to sound the alarm. The station from which this is given is as usual noted on the register, thus saving time in determining where the watchman can be found.

In order to ensure the perfect working of all the stations, apparatus, etc., and to be able to test it daily, the building is wired in such a manner that the wires begin in the engine room and from thence run to all the various stations without loops or branches from the main line, returning again to the engine room, at which point there is a station from which the engineer may, twice a day, or oftener if he chooses, stop his engine by using the

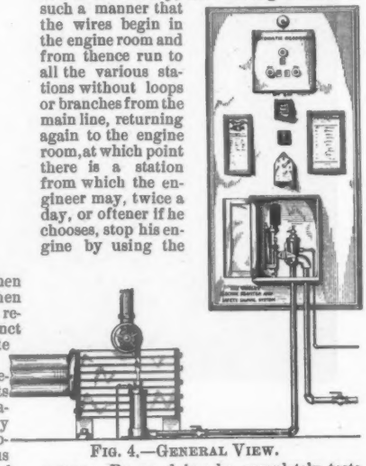


FIG. 4.—GENERAL VIEW.

system. By so doing he completely tests every circuit, and should any of the wires, batteries or appliances fail to be in perfect working order he will be at once cognizant of the fact. It will readily be seen that this constant use is a perfect check on the unimpaired accuracy of this system. The power with which all this is accomplished is but 12 cells of open-circuit battery, the "Samson" being used.

The uses of the system can be divided. For example, if there is no machinery to be controlled, as in the case of hotels, warehouses, stores, etc., and only a watchman is employed, then the registry and fire alarm can be used separately. Again, if only the engine stopping device is desired, the company can furnish this without the other portions. In short, divisions of or additions to the apparatus can be made to suit the requirements of the case. The officers of the company are: Mr. T. W. Robertson, president; Jos. T. Thompson, treasurer; W. W. Henshaw, Jr., secretary, and Chas. E. Ongley, engineer.

Annual Meeting and Report of the Edison General Electric Company.

At the annual meeting of the Edison General Electric Company, held January 19th, 1891, C. H. Coster, James B. Williams, Thomas A. Edison, J. H. Herrick, Samuel Insull, Edward H. Johnson, A. Marcus, Carl Schurz, Francis S. Smithers, Henry Villard and J. Hood Wright, were elected as trustees, and Henry Villard as president, J. H. Herrick as vice-president, Samuel Insull as second vice-president, A. Marcus as secretary, F. S. Hastings as treasurer and assistant secretary, A. S. Beves as assistant treasurer, and Joseph P. Ord as comptroller. At another special meeting it was voted to increase the capital stock from $12,000,000 to $15,000,000. Of the amount of the increase, $2,000,000 will be taken in liquidation of a loan of that amount of cash made last year to the Sprague Electric Railway and Motor Company, one of the subsidiary companies of the General Edison Company. The other million will be reserved to meet future requirements.

The annual report as presented was as follows:

REPORT OF THE BOARD OF TRUSTEES.

To the Stockholders of the Edison General Electric Company: Before proceeding to consider the business of the past year and the prospects for the future, your trustees desire to call your attention to the changes in the organization and management of the company, which formed an important incident in the record of its corporate year.

As set forth in the first annual report, the company started out with the ownership of nearly all the stock of the Edison Electric Light Company; and all the stock of the companies owning the works at Schenectady; the works in New York city producing apparatus and fixtures; the Canadian Edison Manufacturing Company, and the lamp works at Harrison, N. J.; also of the United Edison Manufacturing Company of New York, as the general selling agent for the United States; and also owning a large interest in the Sprague Electric Railway and Motor Company, of which company the entire capital stock has since been acquired.

Each of these concerns was managed as a separate corporation, and the supervision of the business was thus very complicated and imperfect, and, in addition, the large and rapidly growing selling, contracting and constructing business, extending all over the United States and Canada, was conducted through no less than 20 different companies and agencies, all having separate methods and accounts. It was found practically impossible to exercise over so many distinct organizations the close supervision necessary to secure rigid accountability and to conduct the business on an economical basis. It was found, further, that the prevailing system of allowing commissions on business obtained through local agencies was very expensive, without bringing adequate returns.

Your board, therefore, decided, after mature deliberation, to bring about a unification of all the allied manufacturing corporations and selling agencies, of which this company owned or was able to acquire all the stock, by taking over their respective assets and liabilities, thus carrying out a practical consolidation of the corporations, and transferring to this company the absolute ownership of all the property heretofore vested in them. It further determined that the entire business of manufacturing, selling and installing should be conducted in the general company's own name, through its own employés.

The Edison Electric Light Company was excepted from this arrangement; and it remains an active, independent body in all respects.

The autonomy of the Sprague Company, which owns valuable patents, was also preserved, although all its other assets and liabilities have been taken over by the General Company.

The new organization went into effect on August 1st. The United States and Canada were divided into eight geographical districts, each in charge of a district manager, instructed by, reporting and directly responsible to the executive officers of this company. The districts, with their headquarters, are as follows: Canadian district, Toronto; Central district, Chicago; Eastern district, New York; New England district, Boston; Pacific Coast district, San Francisco; Pacific Northwest district, Portland, Ore.; Rocky Mountain district, Denver; Southern district, New Orleans.

It is already demonstrated that this consolidated organization is of great and growing advantage to the company. Great credit for its inception is due to the second vice-president, Mr. Samuel Insull, and to him and the comptroller, Mr. Joseph P. Ord, jointly, for its execution.

FINANCIAL.

The expectation of an increase of business, expressed in the last annual report, was fulfilled much earlier and on a larger scale than was anticipated, and it became necessary to provide for a corresponding enlargement of our manufacturing plants and for additional working capital. For these purposes your board disposed of the unissued capital stock of the company; and the Sprague Electric Railway and Motor Company borrowed $2,000,000, for the payment of which the lenders have agreed to take stock of the General Company.

A special meeting of the stockholders will be held immediately after the annual meeting, in order to consider an act on the recommendation of your board that the capital stock of the company be increased from 12 to 15 millions. Two millions of this increase will be used in liquidation of the abovementioned loan, and the remaining one million reserved to meet future requirements.

As the net earnings of the past year exceed 8 per cent. on the total stock of the company, the trust created under three certain agreements with the Farmers' Loan and Trust Company has reached its termination, and the stock heretofore held thereunder becomes entitled to rate equally in all respects with all other outstanding stock, and to participate in all dividends hereafter paid, including the 2 per cent. payable February 1st, 1891. The stockholders at their forthcoming annual meeting will, in accordance with notice already published, be asked to give consideration to this subject and to authorize the payment of the dividend on the trust stock, together with such other steps as are necessary to have the trust certificates issued by the Farmers' Loan and Trust Company exchanged for the actual stock.

THE BUSINESS OF THE COMPANY.

As an illustration of the magnitude of the business of the company, it may be stated that there are about 6,000 employés on its pay rolls, and that the transactions of the past year represented an aggregate of $10,000,000.

The new fiscal year opens with sufficient orders on hand, notwithstanding the enlargement of our manufacturing facilities, to keep the works fully employed for the next six months; and there is every indication that their increased capacity will be taxed to the utmost throughout the year, as the public is beginning to realize more and more the great advantages and profits resulting from the application of electric light and power to domestic, industrial and transportation purposes.

In the special field in which none of our competitors approach us even remotely, viz, the distribution of light and power from large central stations, a great development is taking place. In New York city, a station, with a maximum capacity of 200,000 lights, the largest in this country, is being erected by the local company, and new stations of large capacity are going up in Brooklyn, Chicago, Milwaukee and Cincinnati.

The local Edison companies obtain their entire electrical plant and additions thereto, including apparatus and fixtures of every kind, from our works; and every new station, therefore, results in a large, new and ever-growing business.

According to the official record, there were in operation on November 1st, 1890, within the territory of the United States and the Dominion of Canada, large and small Edison stations representing an aggregate capacity of 1,371,000 lamps.

In the railway department there was also greatly increased activity. The Sprague car motors sold in 1889–90 represent an aggregate of 27,679 horse-power, and the generators (dynamos for traction current) 22,836 horse-power, as compared with motors of 10,680 horse-power and generators of 7,665 horse-power in 1888–89.

It will not be out of place to mention in this connection that, as the best means of enlarging its business and meeting competition, the management of the company is steadily pursuing the policy of reducing the cost to customers while improving the standard of its products. In this endeavor the management is constantly seconded by the unceasing activity of Mr. Edison, and by the intelligence, skill and experience of a number of its officers and employés. The difference between the present manufacturing methods at our works and those of a few years ago, shows how great is the progress that has been made. A striking illustration is the reduction in the cost of our incandescent lamp.

In view of the value of Mr. Edison's services, the board of trustees take particular satisfaction in stating that the company has entered into a new contract with him, under which he devotes the greater portion of his time to experiments and inventions for it; and the facilities of his laboratory at Orange, N. J., are placed at the disposal of this company.

THE MANUFACTURING ESTABLISHMENTS.

There was expended during the year a total of $949,274.70 for new buildings, new machinery and other additions to the permanent plants. Of this amount, $777,752.64 was invested in the works at Schenectady, and includes the cost of buildings and a portion of machinery for an entirely new branch of business, the manufacture of underground cables, under the patents of the well-known firm of Messrs. Siemens & Halske, of Berlin, Germany, from which large profits are expected. The new investments have more than doubled the capacity of the Schenectady works, and the number of employés was increased from 1,700 to 2,900, while the total product manufactured and sold shows an increase of 117 per cent. over the preceding year.

The enlargement of the lamp works, at Harrison, N. J., called for an outlay of $100,000 (of which $47,554.27 has already been spent), which will increase their capacity from a daily out-put of 11,000 lamps to 25,000 lamps. The reduction in the price of its lamps, which this company was able to make two months ago in consequence of economies in their manufacture, for which it is indebted to the ingenuity of Mr. Edison, has already more than doubled its orders. The sales of lamps increased 64 per cent. over the previous year. The number of employés rose from 379 to 605.

The business of the New York works, formerly known as Bergman & Company, increased 31 per cent., and the employés from 704 to 895.

The growth of the Canadian business will make it necessary to abandon the present small shop at Sherbrook, in the Province of Quebec, as soon as the new and larger works now being erected at Peterborough, in the Province of Ontario, are finished. The present force of 204 men will then be transferred from Sherbrook and largely increased.

EARNINGS.—THE GENERAL BALANCE SHEET AND PROFIT AND LOSS ACCOUNT.

According to the balance sheet and profit and loss account, printed herewith, the gross profits of the business during the year, after deducting $266,071.27 set aside for depreciation of the plants of the several works, and $206,679.15 for general expenses, without including the royalties received by the Edison Electric Light Company, amounted to $1,896,177.06. From this sum various other amounts have been written off, as set forth below. The 6½ per cent. deduction for depreciation was made on the entire plant, notwithstanding additions of $949,274.70, (or about 23¼ per cent., to the property accounts of the manufacturing plants) during the year, on which no appreciable depreciation could have taken place.

The General Company owns practically all of the capital stock of the Edison Electric Light Company, and, therefore, its profits may be considered as part of the General Company's resources. From the statement of the light company, also printed herewith, it appears that its net receipts during the fiscal year were $1,023,011.29 in cash and stocks and bonds of licensed local companies. In accordance with the policy which the light company has always pursued, this sum, together with stocks and bonds formerly acquired, is held in its treasury undistributed.

At the close of the previous fiscal year, there remained a balance of $679,401.48 to the credit of profit and loss on the general company's books. The gross profits of the General Company during the year under review bring the total up to $2,782,257.69. From this there have been deducted $206,679.15 for general expenses; $100,000 charged off against patents; $614,711.41 charged off against cost of acquisition of stocks of subcompanies whose business has been consolidated into this company; and $665,314 for dividends distributed; after which there remains $1,195,553.13 carried into the new year at the credit of profit and loss. This sum does not include the business of the light company as above set forth.

The balance sheet of the General Company shows that the quick assets, consisting of cash, bills receivable and accounts receivable, amount to $3,619,063.59, while the entire liabilities of the corporation, other than those to its stockholders, amount to only $2,647,828.41. Adding to the quick assets above stated the sum of $4,272,903.63, which represents amounts expended on contracts in course of completion, and materials on hand and in process of manufacture, the active working capital of the company over and above its liabilities, appears to be about five and one-quarter millions of dollars.

All materials in stock and in process of manufacture are carried at net invoiced prices. The materials and expenditures on uncompleted work in progress are carried on the books at cost, and without any allowance for profits. This should be kept in mind in considering the value of the total of $4,272,903.63 above referred to.

The Board of Trustees express the thanks of the corporation to all officers and employés for their faithful and efficient service.

By order of the Board of Trustees.

HENRY VILLARD,
President.

*General Balance Sheet October 31st, 1890.**

ASSETS.

Manufacturing plants		$4,085,160.70
Patents (on manufacturing processes and articles manufactured)		296,343.96
Real Estate (on Broad st., N. Y. City)		264,352.28
Capital stock of Edison Electric Light Company		4,343,050.13
Entire capital stock of Sprague Electric Railway and Motor Company (representing Sprague Patents)		680,000.00
Sundry stocks and bonds (of various local electric illuminating and electric street railway companies received in part payment for work done)		398,078.50
Cash	$434,582.75	
Bills receivable	983,805.69	
Accounts receivable	2,200,675.15	3,619,063.59
Work in progress (cost to date of all labor, material, etc., on uncompleted installations)	$1,266,173.85	
Materials and supplies on hand and in process of manufacture)	$3,006,729.78	4,272,903.63
		$17,958,852.81

LIABILITIES.

Allowance for depreciation (for the fiscal year ending October 31st, 1890, 6½ per cent. on all manufacturing plants)		$266,071 27
Mortgages on real estate		200,000.00
Capital stock	$9,370,700.00	
Capital stock held in trust by the Farmers' Loan and Trust Company	2,478,700.00	
Outstanding notes payable in stock at par	2,000,000.00	13,849,400.00
Bills payable	1,776,752.48	
Accounts payable	671,075.93	2,447,828.41
Profit and loss, surplus carried forward October 31st, 1890		1,195,553.13
		$17,958,852.81

*This balance sheet includes all assets and shows every liability of the corporation's entire business, viz, of the general office, of all works, and of all district offices.

E. & O. E.—New York, January 19th, 1891.
J. P. ORD, Comptroller.

Statement of Profit and Loss Account, October 31st, 1890.

EXPENSES.

Expenses of general office	$168,926.00	
Miscellaneous expenses	37,753.15	$206,679.15
Items now written off:		
Patents	$100,000.00	
Net amount charged off during the current fiscal year against cost of acquisition of capital stocks of various sub-companies, whose business has been consolidated into this company	614,711.41	714,711.41
Dividends paid		665,314.00
Balance—Surplus carried forward		1,195,553.13
		$2,782,257.69

EARNINGS.

Profit and loss, Surplus brought over, Oct. 31st, 1889	$679,401.48
Interest accounts, balance for the year, including dividends received	4,740.18
Profits from Nov. 1st, 1889, to Oct. 31st, 1890, not including those of the Edison Electric Light Company	2,098,116.03
	$2,782,257.69

E. & O. E.—New York, January 19th, 1891.
J. P. ORD, Comptroller.

*Balance Sheet, October 31st, 1890.**

ASSETS.

Property Accounts.		
Permanent plant	$9,665.59	
Rental plants	21,307.77	$30,973,36
Trust fund		51,612.39
Cash accounts	$7,626.90	
Bills receivable	10,725.36	
Open accounts	162,400.92	
Doubtful and extended accounts	4,274.07	185,029.25
Stock and bonds		2,988,841.00
Patents		1,342,316.52
		$4,398,772.52

LIABILITIES.

Capital stock		$1,500,000.00
Bills payable	$110,000.00	
Accounts payable	541.26	110,541.26
Sinking fund (against cost of patents)		1,239,064.49
General liquidation account		40,806.28
Profit and loss accounts.		
Profit and loss Sept. 30th, 1889	$466,114.34	
Profit fiscal year ending Sept. 30th, 1890	1,023,011.29	
	$1,489,125.63	
Profit current year to date (1 month)	29,660.03	
	$1,518,785.66	
Less expenses current year to date (1 month)	10,425.17	1,508,360.49
		$4,398,772.52

* The fiscal year ends September 30th.

E. & O. E.—New York, January 19th, 1891.
J. P. ORD, Comptroller.

Brooklyn Lighting Contracts Awarded.

The city authorities of Brooklyn, N. Y., have awarded the contracts for public lighting. The proposals of the Citizens' and the Municipal Electric Lighting Companies were the same as last year—$182.50 per lamp a year. Up to the first of January the former had 1,078 lamps and the latter had 450. The appropriation for lighting the city last year was $455,700. That for 1891 is $500,700. The cost of the 1,528 electric lights in use on the first of January is $278,860 per year, and the cost of 8,590 gas lamps for the same period is $180,222.40; total, $459,082.40.

ELECTRIC LIGHT NEWS

—— The city of Kalamazoo, Mich., is now lighted by 137 electric street lights, 30 of which are police or all-night lamps.

—— Grass Valley, Cal., was deprived of electric lights last week by the freezing of the water power which runs the dynamos.

—— The Big Four Railroad is experimenting with electric light for its passenger coaches, and will probably adopt it on all through trains.

—— The Vicksburg, Miss., Electric Light Company has orders out for three car loads of poles for its lamps. Many of the present poles require renewal.

—— A temporary electric light plant has been put into the new government building at Pittsburgh to facilitate its completion. Two shifts of laborers will be employed.

—— An order has been issued by Mayor Pease to the New Britain Electric Light Company, of New Britain, Conn., forbidding the running of electric lights until further notice.

—— The decline in copper is said to have resulted from the fact that the big electric light companies have stopped buying. The idea is that these companies are waiting for lower prices.

—— The Berkeley, Cal., Electric Light Company will ask the Superior Court for a writ of mandate to compel Thomas Hann, town treasurer, to pay the $500 warrant of the town trustee.

—— The Uniontown, Pa., Light & Heat Company and the Electric Light & Power Company have consolidated under a New Jersey charter. The corporate title of the consolidated companies will be the United Light Company.

—— The Charlestown, Mass., Gas Company's officers take pride in the fact that not one of the company's electric lights suffered by the recent storm, and they think that that is more than can be said of any other street lighting system in their vicinity.

—— Manager W. H. Moore, of the Plainfield, N. J., Electric Light Company, writes us that the statement that his company had been compelled to pay for the death of the horse "Rambo," alleged to have been caused by an electric light wire, is an erroneous one.

—— The fact that only three persons were killed by electric light plants in Massachusetts last year, while eight lost their lives by inhaling illuminating gas, rather goes to show that it is less dangerous to monkey with electricity than to omit to turn off the gas.

—— Herr Lembcke, the director of the school of weaving in Crifield, reports that satisfactory trials have recently been made in the working of silk weavers' looms by electric motors in their own houses. The working of the looms by electrical power from a central station is found to be more satisfactory than the working by means of gas engines.

—— The Lowville, N. Y., Electric Light and Power Company, according to its annual report filed with the Secretary of State, has a paid up capital stock of $30,000; debts, $9,802; assets, $43,285.71. The stockholders are W. H. Morrison, R. P. Grant, Morgan A. Stoddard, John D. Moore, George D. Jackson, Charles W. Harrison, G. M. Skinner, W. J. Morrison, J. Leonard Bush, John D. Hough and Fred. C. Schraub.

—— A suit has been pending for some time between M. R. Muckle, Jr., & Company, of Philadelphia, against the Media Electric Light Company, over a dispute that arose in paying for the plant. It was finally referred to E. Mitchell Cornell, Wm. F. Mathues and Geo. B. Adams, as arbitrators. The claim of the plaintiff was for $9,704.65 with interest. The decision of the arbitrators gave $8,674.76 without interest.

ABOUT ELECTRIC RAILWAYS.

(*Continued from page 272.*)

turbed by the application of another power which is the equivalent of that which they can subsequently exhibit. They are, however, of great importance as intermediate agents in the application of the power of heat as derived from combustion. Science does not indicate in the slightest degree the possibility of the discovery of a new primary power comparable with that of combustion as exhibited in the burning of coal. We, therefore, do not hesitate to say that all declarations of the discovery of a new motive power which is to supersede the use of coal, have their origin in ignorance or deception, and frequently in both."

I wish to call your particular attention to the remarks of Henry in the paragraph just quoted, that electricity and magnetism are of great importance as *intermediate agents* in the application of the power of heat.

In these words Henry accurately foretold the true place of the electric motor in the domain of industry. Not a little confusion of thought exists at the present time in reference to this very point. Every day we hear somebody speak of electricity as if it were a primary motive power.

It only requires a moment's consideration to see that such a view is wholly without scientific basis. Electricity is not a source of power. What, then, I hear the layman ask, is electricity? Those of us who are most familiar with it, have but one answer to that question: *We do not know;* and for my own part, I very much doubt if we ever shall know. This much, however, is certain, electricity is a very convenient and very manageable agency, perhaps a peculiar form of matter, perhaps a peculiar form of energy, by which any quantity of mechanical power may be instantly transferred from a prime motor, such as a steam engine or water-wheel, to a secondary motor at a distance, which is employed to do the required work. It really performs exactly the same office as a belt, or a line of shafting in a factory, which, however useful in *conveying* mechanical power from one point to another can, under no conceivable circumstances, be capable of *originating* it.

The electric motor, therefore, remained, for something like 40 years after its invention, an interesting, but practically useless philosophical toy. It was like half of a pair of scissors—of no earthly use without the other half. The other thing that was needed was an organized machine, which could convert large quantities of mechanical power into electricity. The discovery that it was possible to effect this conversion was also due to Faraday. With his usual sagacity, he had suspected that it might be done, and undertook a series of experiments for the express purpose of finding out. On the second day he wrote to a friend: "I think I have got hold of a good thing, but cannot say; it may be a weed instead of a fish, which, after all my labor, I may pull up." On the tenth day he pulled it up, and it was a *fish;* it was not a small fish either. He had made a discovery which, without injustice, may fairly be compared to Newton's immortal discovery of gravitation. But Faraday was a man who possessed preeminently the scientific mind. His delight in the pursuit and detection of the great truths of nature was so intense and so absorbing, that he was never able to turn from them for the purpose of following up their practical application. "I have rather been desirous," he once wrote, "of discovering new facts and new relations dependent on magneto induction, than of exalting the force of those already obtained, being sure that the latter would find their full development hereafter."

This was the beginning of the development of the magneto-electric generator. The next step is due to the genius of another American scientist and inventor, one whose name will occupy a far more prominent position in the annals of American science a century hence than it does to-day. Moses G. Farmer. He, it was, who in 1867, in a letter to Henry Wilde, of Manchester, England, first described the principle of the modern dynamo-electric machine, and explained to him why the principle of its action was not, as he humorously expressed it, like that of "a man lifting himself over the fence by the straps of his boots."

Almost at the same time similar machines were independently invented by Wheatstone and Varley in England, and Siemens in Berlin. The invention of the dynamo-electric machine gave a wonderful impetus to the investigation of every branch of electric science. The subject was taken up by scores of enthusiastic workers in all parts of the world; improvement succeeded improvement, until we have as a result the exquisitely organized dynamo-electric machine of to-day, a machine which is admitted to have reached a perfection and efficiency which leaves but the narrowest margin for further improvement.

The earliest field of usefulness of the dynamo machine was found in electric arc lighting, which has become in the United States an immense industry. One of the most effective of the early machines was designed by Gramme, of Paris, in 1872, and a number of them were shown by him at an industrial exhibition at Vienna, in the following year. Here occurred one of those extraordinarily fortunate incidents, which again and again have played such a prominent part in the history of industrial progress. In making the electrical connections to one of these machines, not yet belted to the engine shaft, a careless workman attached to it by mistake a pair of wires which were already connected with another dynamo machine which was in rapid motion. To the utter amazement of this worthy artisan, the second machine instantly commenced to revolve with great rapidity in a reverse direction. When the attention of Gramme was called to this phenomenon, he saw at once that the second dynamo was performing the function of a motor, and that what was taking place was the actual transference of mechanical power through a small wire by the means of electricity. This singularly opportune occurrence being commented upon in the scientific journals, led to the almost instant recognition of the true place of the electric motor in the domain of mechanics. The late Professor Maxwell, one of the master minds among electricians of the new era, expressed the opinion that the reversibility of the dynamo machine was the most important discovery of modern times.

The principle of converting mechanical energy into electricity and reconverting this by a reversed dynamo into mechanical power, naturally suggested the practicability of transmitting power through electric wires to any required distance. One of the earliest results of this conception was the revival of the electrically operated railway, the commercial development of which had necessarily remained in abeyance until machinery was available for furnishing large quantities of electricity at a moderate cost.

One fact of controlling importance in this connection is that electricity is capable of being supplied to a moving motor through a frictional or rolling contact; a method of commuicating mechanical power impossible of realization by any other known means. Hence the possibility of supplying a power by machinery situated at any required distance from the moving train by extending the conductor to and along the railway.

The credit of priority in the invention of the electric railway in its modern form—that is to say, the moving electro-motor on the car connected by electric conductors with a stationary dynamo—I believe to be justly due to Stephen D. Field, now of Stockbridge, Mass., who was living in San Francisco in 1877. This was about the time of the introduction of the cable system of street railways, which was resorted to in San Francisco, for the reason that some of the grades were so excessive that the use of horse power was absolutely out of the question. Observing the operation of the cable road, it at once occurred to Field that electric power might be applied to the same purpose with as great or even greater advantage. At that time no dynamo-electric machines suitable for this purpose were to be had in the United States, and he accordingly ordered one from Europe for experimental purposes. It took a long time to make it, but at last it was completed and shipped to San Francisco by a sailing vessel. The vessel was wrecked on the voyage, and the machine went to the bottom of the sea. Not yet discouraged, he ordered another one, which eventually reached him in good order, and enabled him to commence his long-delayed experiments. He tried first an electric elevator, in which he was successful. In 1879, having exhausted his resources, he came to New York, bringing with him his plans, with which he hoped to enlist capital to continue his work. He laid these plans before me, and being impressed with the entire practicability of his scheme, I gave him every encouragement in my power. The plan which he had devised contemplated the enclosing of the conducting wire in a conduit beneath the street. He was not successful in obtaining sufficient means to properly develop his invention; he became involved in tedious, harrassing and expensive litigation with wealthy corporations, and his health failed him at a critical time, so that for years he was incapacitated from active work, but the single railway which is in operation in this country to-day, and embodies his matured conceptions, is regarded by competent judges as in many respects superior to any yet brought before the public. Field's electric locomotive was first exhibited at the exhibition of railway appliances in Chicago in 1883, during the continuance of which 27,000 passengers were transported by it.

In the summer of 1882, Dr. Joseph R. Finney operated in Allegheny, Pa., an electric street car, for which the current was supplied by a copper wire, about the thickness of a lead pencil, 15 or 20 feet above the street. A small trolley fitted with grooved wheels, running on this wire as on a track, and connected with the car as by a flexible conducting cord, served to convey the electric current from the suspended conductor to the motor. Some of the earliest of the successful lines in this country were arranged upon this plan. At a later date this was superseded by the type of contact wheel now in general use, which runs underneath the wire and is mounted upon the end of a long yielding rod bearing a certain resemblance to a fish-pole supported upon the roof of the car.

I have said that the original invention of Field contemplated the supply of electricity to the traveling car from conductors enclosed in a conduit beneath the pavement. He, as well as many other inventors, appreciating the force of that prejudice which undoubtedly exists—among newspaper editors—against any avoidable multiplication of overhead electric wires in the streets, realized that the great prize to be sought for above all others, was the invention of a system of electrical supply which should dispense altogether with the overhead line. Hosts of inventors have diligently wrought for ten years upon this most difficult problem. Hundreds of patents have been taken out, and more than a million dollars have been disbursed in paying for tuition in the costly school of experience. More than once, and in more than one direction, success has at times seemed almost certain; yet truth compels me to say that from the hard practical standpoint of dollars and cents, by which every invention must first or last be tried, the net outcome of all this vast expenditure of labor, time and money, has, up to the present moment, been almost insignificant. The reward which awaits the fortunate person who succeeds in completely solving this problem may well be regarded as a potentiality of wealth beyond the dreams of avarice.

The problem of the underground conduit does not at first sight appear to be a very difficult one. It renders necessary, in the first place, a construction which will effectually resist the action of forces tending to disturb the condition of the wires, and with the heavy traffic on the streets this involves a very strong structure. It is absolutely necessary that the conductors shall remain insulated from each other and from the ground, under all conditions of weather. The exigencies of heavy rains and snows necessitate a construction which shall permit of a thorough insulation of the conductors and a drainage of the entire system. There are other minor points which require to be taken into consideration. Without going into details, it is sufficient to say that the conduit system has been tried on an extensive scale in Denver, Cleveland and Boston, and to a lesser extent in several other places, but in every case the continual interference and interruptions consequent upon its use, have exhausted the patience of the traveling public and compelled its abandonment. I do not wish for one moment to convey the impression that the problem is an insoluble one. My attitude is rather that which was taken by Professor Tyndall some teh years ago upon the question of the practicability of domestic electric lighting by incandescence. He had no doubt that the problem would be solved, but it was a great satisfaction to him to know that it would have to be done by somebody other than himself. I may, perhaps, say that I think great progress has been made in this direction within the past year, and I cannot but feel that the disappearance of the overhead system from the streets of all our larger cities and towns is only a question of time, although the objections which have been most strenuously made to its introduction are for the most part rather of a sentimental than of a practical character.

The storage battery system, both from the standpoint of the public and of the street-car manager, is an ideal solution of the problem of electrical transportation. It has many features which especially commend it for city work. Each car is an independent unit, and hence no accident can materially cripple a well-organized system. The idea of being able to store a large quantity of electricity in a box under the seats of a car, to carry it round, and to draw from it a large amount of power, as required, is a most attractive one. Storage battery cars can be introduced in the existing systems, one car at a time. In cases of emergency they can be run over almost any route where a horse car can be run, not being restricted to the route of an electric conductor, and under ordinary circumstances the car can be run just as rapidly, and controlled just as effectively as it can be with the trolley system.

All these advantages were recognized at an early day, and hardly had the storage battery been invented before it was applied to street car propulsion. The first storage car was operated in Paris, in 1882. The system was put in practical service on one of the lines in Brussels, Belgium, and continued for two years. It was also introduced in 1886, on the Madison avenue line in New York City, and has been in operation there ever since. The results of the ten cars now running on the Madison avenue line appears to have demonstrated that the system may, with careful management, be made thoroughly reliable. Each car will carry a full load on a straight and level track, 15 miles per hour, and will ascend grades not exceeding five per cent., and not more than 500 feet long, at five miles per hour. A run of 40 miles can be made on a level track, which is considered half a day's work, with one charge of battery. The time required to replace the exhausted batteries with fresh ones, is not more than two minutes. There are, however, two serious objections to this system which have thus far been sufficient to prement its adoption in other than exceptional cases. One of these is the great weight of the batteries, and the other is the lack of reserve power in the emergencies which sometimes occur. In other words, two considerations enter into the question, one of economy and the other of efficiency.

To take up the question of comparative efficiency first, a very little consideration of the matter will show that the progress of the art so far as yet developed, practically limits the use of storage battery cars to lines having very light grades—not more than 5 per cent. at the outside. Very many of our eastern cities, for instance, Springfield, Providence, Worcester, Albany, Troy, and many others which I might mention, have very severe grades, from 7 to 10 per cent. and some of them half a mile long. To start a heavily loaded car in bad weather on such a grade as this, means an expenditure for a few seconds of from 50 to 80 horse-power. Experience has shown that this is far too heavy a tax upon the powers of a storage battery. Even on comparatively level lines, in our northern climates, the occurrence of a heavy storm of snow or sleet necessitates the expenditure of an abnormal amount of power, and it is on just such occasions as these, when everybody wants to ride, so that the cars are loaded to their utmost capacity, and great dissatisfaction prevails if there is any delay, or any lack of sufficient accommodation. It is at such times as this that the advantages of a distribution from a central station are most apparent. The whole number of cars or extra ones, if necessary, can be run, and any amount of power required to force them through obstructions and to keep them running on schedule time can be supplied from the power station. It is merely a question of burning more coal.

Considering the economical aspect of the question, first, as to the original cost, it may be said roughly, the difference between the storage and overhead line system is not very great. The whole outfit, exclusive of road-bed, track and building, for either system, will aggregate perhaps $10,000 per car. Now as to the cost of maintenance and operation:

A 16-foot car with two motors, such as are most commonly used, will weigh 8,000 lbs., of which 4,000 is electric apparatus.

A storage battery car of the same size and capacity weighs 14,000 lbs., of which 3,800 is battery.

A full load may be estimated at 30 passengers, weighing about 4,000 lbs.

It will be seen that the storage battery car weighs nearly as much as two ordinary electric cars. It seems at present impracticable to operate a car with less than 3,800 lbs. weight of battery, and unless great improvements are made, there is little reason to hope that this weight can be materially reduced.

What is termed the *commercial efficiency* of an electric railway is the ratio between the power generated by the steam engine and that exerted upon the car wheels. We may call the weight of the car body and truck, plus the full load of passengers, the *useful load.*

The best authorities seem to concur in the opinion that it requires, roughly speaking, nearly twice as much power per unit of useful work done, with the storage battery system, that it does with the direct distribution system. The dead weight of the battery is nearly equal to that of a paying load of 30 passengers, and this load must be transported whether there are any passengers or not. The increased weight adds to the cost of renewal and repairs, both of the track and of the cars.

The cost of horse-power for drawing cars has been found by long experience to vary from 10 to 11 cents per car per mile. The cost of power for the ten storage battery cars on the Madison avenue line in New York is said to figure out 10.6 cents per car per mile, practically the same as horse-power.

A careful computation of the average cost of power by the direct distribution system, on a considerable number of different lines in this country, shows that the cost for coal, attendance, real estate, oil and waste, repairs of machinery and line, foots up 5.09 cents per car per mile.

You will bear in mind that I am now speaking solely of the cost of *power*; the greater part of the expenses of any street railway company remain substantially unchanged whatever kind of power is used.

We often here people say, "What difference does it make to us how much the power costs the railroad company? We pay five cents per trip, no more, no less." It is only a question of increasing or diminishing the profits of the corporation. But this is a very short sighted way to look at the question. Increased economy in conducting transpor-

tation means more frequent and less crowded cars, greater speed, more branch lines, and better accommodations in every way. You still have to pay your five cents, it is true, but you must remember that you get a great deal more for your money.

I once had occasion to study this whole question very minutely. In the fall of 1886, when the West End Street Railway Company, of Boston, was first organized, I was commissioned by President Whitney to make for him a careful investigation of the subject of electric propulsion, which he desired to apply to the entire street railway system of Boston. It was a gigantic proposition, for at that date there was hardly a dozen electric street cars running in this country. I was told by him at the outset that I must confine my researches to conduit and storage systems; that anything in the shape of an overhead line was out of the question and would never be tolerated in Boston for a moment. I submitted my report to Mr. Whitney on the 30th day of April, 1887. At that time no experience had been gained which would enable me to compute accurately the cost of operation of the different systems, but the final result of my estimate then given to Mr. Whitney, of the cost of power per car per mile, was as follows:

Horse power	11.07 cents.
Electric storage system	7.34 "
Electric underground distribution	6.02 "
Electric overhead distribution	3.28 "

It will be seen that these figures estimated the cost of the storage system as a little over twice that of the overhead system. Experience has confirmed the substantial accuracy of my original estimate in respect to relative cost. The absolute cost for all electric systems is considerably greater than was anticipated. This is partly due to the item of repairs for the electric motor and gearing, which are found to be subject to much greater wear and tear than experience had given reason to anticipate, and partly to the great increase in the number of passengers per car mile, caused by the popularity of the electric cars, which adds greatly to the loads carried.

Mr. Whitney then authorized me to construct an electric car operated by storage batteries, and to give the practicability of the scheme a thorough test. This pioneer car, the very first electric car of the West End Company, was put in service in the early part of October, 1887, and was run for some time between Cambridge and Boston. A careful series of tests and measurements showed the cost of operation to be about the same as that of a horse car of equal capacity. The West End Company continued to experiment, putting down the next year an expensive conduit line on Boylston street, in Boston, and an overhead line on the extension of Beacon street in Brookline. The comparative results of the practical trial of the three systems was so favorable to the overhead line, that the objections of the citizens of Boston were gradually overcome, and at length overhead wires were permitted to be placed in the streets of the city proper.

Finally, I proposed to consider the question whether there are any valid reasons why the public should object to the introduction of electric railways, or why the municipal authorities should hesitate to grant the necessary franchises?

Are electric railways dangerous?

With a view of getting at the actual facts in the case, the *Boston Advertiser*, a few months ago, sent out a circular letter asking information from every city in which electric railways are in actual operation, from Portland, Me., to Galveston, Tex. It was asked what system was used in each place; whether there had ever been loss of life or injury from the wires; whether there was any serious objection on the part of the public to overhead wires, and what was the general opinion in the locality as to the effect of the introduction of electricity upon the street railway service? Replies were published from 64 cities and towns. All but four of them were favorable. Not one solitary instance of accident or serious injury from electric currents was reported.

An extraordinary amount of nonsense has been printed and talked in respect to the alleged dangers of both electric light and railway wires. The public have been needlessly alarmed by the exaggerated statements of interested parties, but, nevertheless, the danger is so small, as a matter of fact, that the actual figures are almost astonishing. Most of the accidents which have been reported occurred in New York city. Yet the statistics show that in 1889, out of 1,467 deaths in New York city, by accidents of various sorts, only *nine* were due to electricity, a considerably less number than were killed by being run over by horse cars. Not a single death was recorded in Boston, although there are perhaps more wires there in proportion to the population than in New York. There are in the six New England States nearly 140 arc light stations, burning over 20,000 arc lamps and distributing 30,000 horse-power of electricity through the streets of the principal cities and towns. During the last 10 years, so far as I can ascertain, there have been but *five* deaths from electricity; four of these were employés of the lighting companies, and one was a careless boy who climbed upon a shed and took hold of a wire. During the same 10 years the steam railroads of New England have killed 2,339 employés and 2,902 other persons! 5,241 against 5! Not only is electrical power far less dangerous than the same quantity of power used in other industries, but it is relatively safer, as the few accidents that do occur, are among the employés. These remarks refer to electric wires in general. Now as to electric railway wires:

I believe that it is an incontestable fact that not one single man, woman or child has ever been killed or even seriously injured by a 500 volt current, which is the highest pressure ever permitted upon electric railway wires. Every alleged case of accident by railway wires has, upon investigation, proved to be either without foundation, or to have been caused by an electric light current. When we consider that shocks have been experienced by men, women and children; persons of all ages and all sorts of physical condition, sometimes for a period of several minutes, experience seems to warrant the positive assertion that the electric railway current is not dangerous to human life, and that we may dismiss that question from further consideration.

Many persons are alarmed at the vivid flashes of light which are often seen at night beneath the wheels of an electric car, and at the point of contact of the trolley wheel with the overhead wire, and are under the impression that they must indicate a very dangerous electric pressure. Such, however, is not the case. In an electroplating establishment at Ansonia, Conn., I once saw a workman accidently set a tin pail filled with water upon a pair of electric conductors near the dynamo. The pail instantly disappeared, being not merely melted, but being converted into metallic vapor, with a terrific flash which illuminated the whole building with a dazzling and instantaneous radiance; yet the current which produced this startling phenomenon was of such low pressure that it was impossible to detect its presence by the sense of touch, even by applying the hands directly to the bare conductors.

The average speed of the horse car is about six miles per hour. The question is sometimes asked, How fast may electric cars be safely run in a city street? One fact within my own knowledge will go far to answer this question. There is a heavily traveled street in Pittsburgh only 36 feet wide, containing a double-track cable road, which leaves not more than ten feet space on each side. At first the cable cars were run at the rate of seven miles per hour; afterwards the speed was increased to nine and one-half miles per hour. The records show that there are not so many accidents under the present arrangement as there were before. Pedestrians and drivers are more careful and take fewer chances. The schedule rate of the electric cars in Cleveland is nine miles per hour, and in some parts of Boston as high as 12. The value of an electric railway to the public is largely determined by its speed, but the economical aspect of the question is equally important. If we make six miles per hour with horses, and nine with electricity, each car does 50 per cent. more work without increased expense for conductors' and drivers' wages, which is an important item. Another economical feature due to the use of electricity, is the ability to haul one, or even two, tow cars without loss of schedule time on special occasions when the traffic is unusually great.

Nothing is more astonishing than the capacity of the electric cars to make their schedule time in the face of the heavy storms of a northern winter. It is a common sight to see an electric car running, apparently with perfect ease, up a steep grade through snow a foot deep, pushing or pulling other cars loaded to their utmost capacity.

The total number of electric cars now running in this country is probably between 2,500 and 3,000. Of the whole number, I presume not more than 30 or 40 are operated by storage batteries. The fact that the overhead system, though introduced at a later period than either the storage system or the underground distribution system, has so far surpassed them both, goes far to show that as yet it is the only system which has been able to meet the various exacting requirements of our street railway service.

I regret that the necessary limitation of time does not permit me to mention more at length the work of other American inventors, to whom the development of the electric railway is largely indebted. Among them are Charles J. Van Depoele, of Chicago, now with the Thomson-Houston Company, at Lynn, who exhibited a car in operation in Chicago, in 1883; Leo Daft, whose motor drew a full sized passenger car over the Mt. MacGregor railway at Saratoga, in 1883; and especially, Lieutenant Frank J. Sprague, who designed, carried out and completed, the first installation of electric railroading on a large scale in the world, in Richmond, Va., in 1888. This was a road 12 miles in length, with a great number of curves, a bad track, numerous grades of 10 per cent. and over, and an equipment of 40 motor cars. Laboring under enormous difficulties and drawbacks, Lieutenant Sprague succeeded, by the completion and operation of this plant, in establishing, beyond peradventure the future supremacy of the electric street railway, and many of the characteristic features at that time designed and introduced by him have practically become standards in the modern system, and are found in nearly every one of the thousands of cars now in service.

The limits of time compel me to content myself with the briefest possible reference to the most important development of electrical transportation which has yet come before the public; the electric underground railway. This undertaking having been placed in the hands of electrical engineers whose competency cannot be questioned, and backed by ample capital has proved in London a phenomenal success. We are now assured that a syndicate of the most prominent capitalists of New York have undertaken to establish a system of transportation upon the same plan, consisting of a network of tunnels at a depth of 100 feet beneath the surface, and connecting all important points not only in the city itself, but in the adjacent sections of Long Island and New Jersey. In such a system it necessarily follows that the train must be run by electricity to the exclusion of any other power.

Every thoughtful person realizes that something must be done at once, not only to relieve the congestion of traffic which already exists in the streets of New York, but to provide for the enormous yearly increase which must be taken into the account. Statistics show that the traffic of the horse cars and elevated lines in New York has increased 46 per cent. within the five years from 1884 to 1889. A careful estimate which has recently been made of the movement of passengers in and about New York during the year 1890, gives the following amazing results:

New York city (surface and elevated roads)	400,000,000
Brooklyn Bridge	38,000,000
Long Island ferries	90,000,000
Staten Island and New Jersey ferries	85,000,000
Total	603,000,000

If the profit derived from carrying these passengers amounts to only one cent each per trip, it nevertheless figures up to the snug little sum of $6,000,000 per annum, which makes a very comfortable dividend upon a capital of $100,000,000. Such a system would admit of the running of solid trains at very short intervals through the city, to and from all points in the suburbs, in every direction, and I venture here and now to predict that within the next 20 years, if not the next 10 years, electrical underground transportation will be brought to such a state of perfection, that a passenger entering one of the central stations of New York may be deposited at his home station at any point within a radius of 10 miles, in 15 minutes time, and at a fare of five cents. And this magnificent result is to be the contribution to the convenience and the prosperity of the public of the electrical engineer.

At the conclusion of Mr. Pope's address, a vote of thanks was unanimously tendered for the very interesting lecture. The discussion was participated in by Mr. J. A. Powers, of Troy; Dr. Otto A. Moses and Mr. F. R. Colvin. Afterwards the meeting adjourned.

Electric Mutual Insurance Company.

The business of the Electric Mutual Insurance Company, of Boston, for the seven and a-half months to the first of January, is given as follows: The total amount written by the company amounts to $2,897,587, divided, as to sections, thus: New England, $1,124,222; Middle States, $623,310; Western States, $730,020; Southern States, $393,525; Provinces, $26,500. Of the above sum, $803,267 is on manufacturing property, received from the factory mutuals, leaving $2,094,325 insured upon electrical plants carried at the company's risk. To this latter amount is to be added $1,088,500, in surplus lines on electrical plants given to the factory mutuals, and $589,875 bestowed on the stock companies, making the grand total of insurance on electric plants secured by the Electric Mutual, $3,772,700. The total of losses to the company have amounted only to $137.38. This is certainly a showing of which many older institutions of the kind might be proud.

The overhead wires originally selected for the telephone service in London were galvanized and weighed 224 pounds to the mile, but these are now replaced by silicon bronze weighing 36 pounds per mile.

ELECTRIC CLUBS.

New York Electric Club.

Messrs. Jas. MacMahon and J. F. MacMahon, of the renowned Australian theatrical firm of MacMahon Brothers, were recently the guests of Mr. Felix Gottschalk, of the Automatic Phonograph Exhibition Company, of this city. During their visit to New York, the Messrs. MacMahon engaged a district messenger boy to perform a little service for them. The boy, although slow of foot, was quick of mind, and sizing up his whilom employers for strangers, charged for his time at the rate of a dollar an hour.

Recent Out-of-Town guests were W. A. Willard, Brooklyn; Jas. MacMahon and J. F. MacMahon, Melbourne, Australia; L. H. Rogers, Boston; J. F. Morrison, Baltimore; Walter S. Beresford, England; L. S. Dumoulin, Boston; Hamilton Wallis, East Orange, N. J.; G. E. Keasel, Frank M. Paul and E. V. Cavell, Chicago.

Institute of Electrical Engineers.

At the 53d Meeting of the Institute, held at 12 West 31st street, New York, the evening was devoted to the thorough discussion of Mr. Kennelly's paper on "Inductance and its proposed Unit, the Henry," also the report of the committee appointed to consider the proper magnitude of the unit. The report of the committee was finally adopted, and is as follows:

At a meeting of the American Institute of Electrical Engineers, held September 16th, 1890, a committee consisting of Dr. Wm. E. Geyer, Dr. Louis Bell, George M. Phelps, Edward A. Colby and Francis B. Crocker, chairman, was appointed to consider and report upon the best value for the "henry," the proposed practical unit of self-induction or inductance.

After careful consideration, the committee has reached a conclusion and now recommends to the Institute the retention of the present value of the practical unit, which is 10^9 absolute units of inductance, usually expressed as a length equal to one earth's quadrant or 1,000,000,000 centimetres.

The committee finds that this value is too high in some cases for convenience, as many practical measurements of inductance would have to be expressed in fractions of a henry. At the same time, other practical values would often amount to a number of henrys, and sometimes to hundreds or even thousands of henrys. It is, of course, impossible to have a unit fit all cases, and in this instance it happens that the average practical inductances would approximate one henry in value. This may be considered fortunate. Small values may be conveniently expressed in millihenrys, analogous to milliamperes, etc.

The committee is of the opinion that even if the value of this unit (10^9 absolute units) had been much less convenient than it is, nevertheless, it would probably be very unwise to change it, for the reason that it is derived from and related to the other practical units in the ratio of one to one, just as one ampere is equal to one volt divided by one ohm. To depart from this plan which has always been followed heretofore, would tend to destroy the harmony of the entire system of practical units. The same fact made it necessary to define the farad as a capacity of one coulomb at one volt, although this makes its value so enormous that the microfarad is always used in practical work. It appears, therefore, to the committee, that the value of the "henry" should certainly be fixed at 10^9 absolute units of inductance.

At the Regular Monthly Meeting of council of the American Institute of Electrical Engineers, it was voted to change the date of the 54th meeting, from February 17th to the 24th, in order to avoid conflicting dates with the convention of the National Electric Light Association, and also to afford members of the latter an opportunity of attending the Institute meeting upon their return from Providence.

Mr. A. H. Hardy Trott was elected a life member, and the following associate members also elected: F. C. Bates, Wm. J. A. Bliss, Edward Caldwell, Charles F. Chandler, Gustave J. Fischer, Samuel V. Hoffman, Arthur B. Levy, Thos. R. Taltavall.

Suit Against a Smelting Company.

The Cowles' Electric Smelting and Aluminum Company, of Lockport, N. Y., has entered suit in the United States circuit court against the Pittsburgh Reduction Company for damages for the alleged infringement of four patents. The patents are on improvements in electric processes of smelting ore for the production of alloys, bronzes and metallic compounds, an electric furnace and method of operating the same, and two improvements on the furnace. An injunction is also asked for to restrain the defendants from continuing the infringement.

KINDRED INTERESTS

M. S. Shapleigh, 112 South Fourth street, Philadelphia, is having quite a run on a neat little self-registering wire gauge which was recently placed on sale. It is small, cheap and accurate.

Stanley & Hall, electrical house furnishings, 32-34 Frankfort street, New York, have begun the new year well by issuing a very complete catalogue. It is handsomely made, and well printed and illustrated.

The Universal Arc Lamp Company, 49 West 22d street, New York, have published a very tasteful catalogue and price list of their arc lamps. The illustrations and reading matter are of a high order and the testimonials convincing.

The International Okonite Company, limited, has declared a dividend for the six months ending December 31st, on the capital stock of the company at the rate of 8 per cent. on the preference and 10 per cent. on the ordinary shares.

The Ansonia Brass and Copper Company have sent us a new year's souvenir, which is both novel and beautiful. It is a collection of six steel engravings, showing the four large mills of the company at Ansonia, the clock factory in Brooklyn, and the New York store, all bound in a celluloid cover with a handsome design.

The Sunbeam Incandescent Lamp Company, Chicago, have recently moved into larger quarters, having four times the space of the premises formerly occupied. With specially designed and modern apparatus, they are prepared to fill any order. At no time since June last have they been able to keep up with their orders as received.

The Central Electric Company, who seem to be always on the alert for desirable specialties, will shortly place upon the market a direct reading voltmeter and ammeter. It is claimed that this new instrument is as good as any that has been produced. It will be elegantly finished, as well as thoroughly standardized, and will be sold at a price so low that every one connected with electrical work can afford to buy one.

The Thomson-Houston Electric Company report the following recent sales of apparatus, made through the Philadelphia office: Warden Apartment House, Philadelphia, 2,000 incandescent; Eastern Penitentiary, Philadelphia, 800 incandescent; McKeesport Light Company, McKeesport, Pa., 50 arc; American Tube Company, Middletown, Pa., 50 arc; Edison Illuminating Company, Easton, Pa., 50 arc; Bloomsburg Electric Light Company, Bloomsburg, Pa., 50 arc, 650 incandescent; Chelberham Electric Light Company, Oak Lane, Pa., 1,300 incandescent; Clifton Electric Light Company, Landsdown, Pa., 1,300 incandescent; Lewistown Electric Light Company, Lewistown, Pa., 1,000 incandescent; Monterey, Mexico, 70 arc, 1,300 incandescent; Hudson Electric Company, Hoboken, N. J., 650 incandescent.

Brush Electric Company.

At Cleveland, January 19th, the election of officers of the Brush Electric Company under the new *regime* was held. The election resulted as follows: President, S. A. Barton; first vice-president, J. S. Bartlett; second vice-president, C. A. Coffin; treasurer, J. Potter; secretary, S. M. Hamill; general manager, C. S. Pease; electrician, Prof. S. A. Short; general counsel, W. B. Bolton; assistant treasurer, J. S. Hughes; assistant secretary, L. B. Levake.

The meeting passed off harmoniously and quietly. Messrs. Brush, Stockley and Tracy resigned from the directorate, their places being filled by Messrs. Barton, Bartlett and Coffin. Mr. Pease was also elected a director. No changes have nor probably will be made in the New York offices or the management of the shops. The policy of the company will remain about the same as before. In the evening, after the election, the old and new officers and a number of prominent people were dined by Mr. Brush at his elegant residence.

PAISTE CHINA SWITCHES.
HANDLE, CAP AND BASE,
Made of Ivory Colored China.
JUST THE THING FOR FINE RESIDENCE INSTALLATIONS.

PRICES AWAY DOWN ON ALL
PAISTE SPECIALTIES.
H. T. PAISTE,
1201 Market Street,
PHILADELPHIA, PA.
THE PAISTE SPECIALTIES
KEPT IN STOCK AND FOR SALE BY ALL PROMINENT SUPPLY HOUSES.

Westinghouse Affairs.

The Pittsburgh *Chronicle-Telegraph* gives these particulars of Mr. Westinghouse's statements of the condition of his different properties:

The Air Brake Company has a capital of $5,000,000, no debts and large available assets. For two years it has earned 25 per cent. per annum. It also owns a controlling interest in the English company, which pays 6 per cent., and has accumulated a surplus of $1,500,000.

The Union Switch and Signal Company pays dividends on $500,000 preferred stock and nothing on the common.

The Westinghouse Machine Company has a capital of $500,000, and earns 20 per cent.

The Philadelphia Company has a capital of $7,500,000, paid 12 per cent. for four years and 8 per cent. up to the present quarter; $2,000,000 have been taken from earnings and put in pipe lines. By using all its earnings for a short time this company can free itself of debt.

The Standard Underground Cable Company has a capital of $1,000,000, and earned 25 per cent. in 1890.

The Allegheny County Light Company earned 8 per cent. on $1,000,000 capital, of which half is issued.

The Fuel, Gas and Manufacturing Company has $1,000,000 capital, and earned 12 per cent. the first year.

The Westinghouse Electric and Manufacturing Company is the only one in trouble, and this can be fixed by the sale of 30,000 or 40,000 shares of preferred stock. Its capital is $7,000,000 common and $3,000,000 preferred stock, none of the latter issued. It has book assets amounting to $10,000,000, and its floating liabilities amount to $3,300,000. Keen competition has made collection of accounts slow and difficult. In 1890, the company's sales aggregated $4,700,000. Mr. Westinghouse said he had placed between 22,000 and 24,000 shares of the preferred stock, and expects to place 40,000 shares.

FINANCIAL.

Closing quotations of electric stocks, from F. Z. Maguire & Co., Electrical Securities, 18 Wall street, N. Y., Saturday, January 24, 1891. New York, Boston and Washington Stock Exchanges. Pittsburgh closing January 24.

NEW YORK.	
Western Union Telegraph Co.	78½
American Telegraph & Cable	82
Central and South American	*145
Mexican	*210
Commercial Cable Co.	104
Postal Telegraph Cable	39
Edison General Electric Co.	94
" Deferred	
Consolidated Electric Light	
Edison Electric Illuminating Co.	70
United States Electric Light	30
North American Phonograph	
BOSTON.	
Thomson-Houston Electric Co.	43
" " " Preferred	25¼
" " " Series C	
" " " Series D	5½
" " International Co.	
" Welding Co.	
" European Welding Co.	58
Ft. Wayne Electric Co	11
TELEPHONE:	
American Bell	208
Erie	49
New England	51
Mexican	.60
Tropical American	
MISCELLANEOUS:	
Edison Phonograph Doll	1
WASHINGTON.	
Pennsylvania Telephone	25
Chesapeake and Potomac	*63
American Graphophone	9⅝
United States Electric Light (Wash'ton)	138
Eckington and Soldiers' Home Electric Railway	50
Georgetown and Tennallytown	49
PITTSBURGH.	
Westinghouse Electric Mfg. Co.	8½

* Ex. Div.

The Electrical Commissioners of the District of Columbia invite communications from firms interested in electric cables, conduits, subways, etc. Also upon the subject of municipal electric lighting, electric transmission of power, etc. Communications received until March 1, 1891. Personal interviews cannot be granted at present.

Address, ELECTRICAL COMMISSION,
Room 30, District Building, Washington, D. C.

Burnley Dry Battery
PATENTED JAN., 1890.

STRONGER than any Open Circuit Battery on the Market.
BETTER than any other Dry Battery yet produced.
Most compact in size and cheapest. 90 cents per cell.
Discount to the Trade and in quantities.

J. H. BUNNELL & CO.,
Sole Manufacturers and General Agents,
76 CORTLANDT ST., N. Y.

Railroad Rates to Electric Light Convention.

NATIONAL ELECTRIC LIGHT ASSOCIATION, PROVIDENCE, R. I., FEBRUARY 17TH TO 19TH.

For this occasion the Michigan Central in connection with the New York Central and the Boston and Albany R. R., will make a rate from Chicago to Providence and return at one fare and a third (1⅓) on the certificate plan, amounting to $29.35.

These rates will apply to delegates, members of their families, and friends who desire to accompany them.

It is expected that a majority of the members from Chicago and the West, will leave Chicago on the North Shore Limited *via* the above-mentioned route, at 12.20 noon, February 15th, which train will arrive in Providence at 7.35 the next evening, being but one night in transit.

As this is a limited train and the accommodation being therefore limited, it is important that applications for space should reach the undersigned promptly. He will also furnish the necessary certificates to secure the reduced rates.

L. D. HEUSNER,
Passenger and Ticket Agent, M. C. R. R.,
67 Clark St., Chicago, Ill.

ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENTS OF THE UNITED STATES WERE ISSUED ON JANUARY 20, 1891.

444,807 Combined electric motor and lamp socket; Ralph H. Beach, St. Paul, Minn.

444,819 Railway signal; Nathaniel B. Cregier, Chicago, Ill.

444,825 Electric gate; Harleigh Gillette, Highland Park.

444,855 Portable electric welding apparatus; Elias E. Ries, Baltimore, Md.

444,879 Insulator; Charles Elkins, Saccarappa, Me.

444,881 Electrical exercising machine; Joseph B. Gardiner, Nyack, N. Y.

444,893 Trolley for electric railways; Harry H. Beades, Detroit, Mich.

444,896 Automatic electric igniting device; Thos. W. Lane, Boston, Mass.

444,900 Regulating apparatus for electric motors; Merle J. Wightman, Scranton, Pa.

444,905 Spring motor; Eli S. Reed and Carl T. Painter, Chattanooga, Tenn.

444,906 444,907 444,908 Spring motor; Eli S. Reed, Chattanooga, Tenn.

444,914 Electric blank heater for forging machines; George D. Burton, Boston, Mass.

444,922 Mounting for electric car motors; Edwin W. Rice, Jr., Lynn, Mass.

444,925 Electric arc lamp. 444,926 444,927 444,946 Method of electric welding; Elihu Thomson, Lynn, Mass.

444,928 Method of electric welding. 444,929 Incandescent electric lamp. 444,930 System of distributing and metering electric energy. 444,931 Electric meter; Elihu Thomson, Swampscott, Mass.

444,934 Alternating current motor; Carl O. C. Billberg and Paul N. Winaud, Philadelphia, Pa.

444,939 Alternate current dynamo; Hermann Lemp and Louis M. Schmidt, Lynn, Mass.

444,966 Electric indicator; Charles Wirt, Orange, N. J.

444,969 Electrode for secondary batteries; Foree Bain, Chicago, Ill.

444,977 Electric arc lamp; William H. Elkins, Hornellsville, N. Y.

445,008 Insulator; William Vogler, Somerville, Mass.

445,023 Independent electric clock; Edouard Lefebre, Montreal, Canada.

445,051 Electric motor truck; Royal P. Faries, Wichita, Kan.

445,102 Electric motor reciprocating engine; Charles J. Van Depoele, Lynn, Mass.

445,106 Electric signal for railroads; Edgar C. Wiley, Bristol, Tenn.

445,144 Electric railway car; Rudolph M. Hunter, Philadelphia, Pa.

445,146 Electric switch; Benjamin B. Keyes, Chelsea.

THE
REMINGTON
has set the copy for writing machines for 15 years.
It is to-day the
STANDARD
and expects in the future, as it has in the past, to lead all others in adding improvements to what will always be the true model of a
TYPEWRITER
Wyckoff, Seamans & Benedict,
327 BROADWAY, NEW YORK.

MAP OF THE UNITED STATES.

A large, handsome Map of the United States, mounted and suitable for office or home use, is issued by the Burlington route. Copies will be given free when it can be done without expense for transmission, or they will be mailed to any address, on receipt of six cents in postage, by

P. S. EUSTIS,
Gen'l Pass. Agent, C., B. & Q. R. R., Chicago, Ill.

THE HIGHEST

ABRASION-RESISTING AND STRONGEST WIRES IN EXISTENCE

— ARE THE —

AMERICAN CIRCULAR LOOM COMPANY'S

"CANVAS JACKET"

INSULATED WIRES AND CABLES,

BOSTON: 620 ATLANTIC AVENUE.

SELLING AGENTS:

NEW YORK.—B. and S. Elec. Equipment Co., 115 Broadway.
CHICAGO.—Illinois Elec. Material Co., 341 Rookery Building.
PHILADELPHIA.—Clay & Pepper, 1218-1220 Filbert Street.
PITTSBURGH.—Mill and Mine Elec. Equipment Co., 95 Fifth Ave.

AN EXCELLENT ARTICLE.

The P.&B. TRADE MARK REGISTERED INSULATING * * * * * TAPE.

MANUFACTURED ONLY BY

THE STANDARD PAINT CO.,

RALPH L. SHAINWALD, Pres., 59 MAIDEN LANE, NEW YORK.

WANTED.—Position as electrical engineer or representative of electric company (railway preferred), or as superintendent of electric street railway company. Four years' experience in electric business.

Address, ELECTRICAL ENGINEER,
Care of ELECTRICAL REVIEW, N. Y.

IF YOU have anything pertaining to electric machinery you want to sell, send us the description.

IF YOU want anything pertaining to electric machinery, send us your inquiries.

FRANK RIDLON & CO.,
Dealers in New and Second-Hand
Electric Light & Power Machinery,
196 SUMMER STREET, BOSTON.

THE LAW

Double Cylinder Battery.

Surface of negative element and quantity of solution double that found in any other open circuit cell.

Weigh carefully these advantages.

Its sale has steadily increased for ten years.

LAW TELEPHONE CO.,

Sole Makers,

87 JOHN STREET, NEW YORK.

WANTED—to learn the Electrical Business—at the Wenstrom Dynamo and Water Works, in Baltimore, 100 bright boys, between 16 and 20 years of age. Must be well recommended as to moral character and possess a good elementary education. Apply by mail, in handwriting, when blank form of application, with conditions required, will be forwarded.

Wenstrom Consolidated Dynamo & Motor Co.

No. 7 N. CALVERT ST.

Baltimore, Md.

PATENT PERFORATED

ELECTRIC LEATHER BELTING

MANUFACTURED BY

Charles A. Schieren & Co.,

45, 47, 49, 51 FERRY ST.,
COR. CLIFF ST.

BRANCHES:
BOSTON, 119 HIGH STREET.
PHILADELPHIA, 226 NORTH 3d STREET
CHICAGO, 46 SOUTH CANAL STREET.

ELECTRIX SWITCH.

ELECTRIX SPECIALTIES.

Endorsed the World over by Users.

Simple. Reliable. Indestructible.

DEALERS REPORT QUICK SALES.

CORRESPONDENCE INVITED.

THE STAR ELECTRIX CO.,

1320 Wallace St., Philadelphia, Pa.

EUGENE F. PHILLIPS, PRESIDENT. W. H. SAWYER, SEC. & ELECTRICIAN.

AMERICAN ELECTRICAL WORKS,

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

MAGNET WIRE, OFFICE & ANNUNCIATOR WIRE.
RUBBER COVERED WIRE, LEAD ENCASED WIRE.
TELEPHONE & INCANDESCENT CORDS.

FARADAY CABLES.

Office and Factory, 67 STEWART STREET., PROVIDENCE, R. I.
New York Office, 10 Cortlandt St., P. C. Ackerman, Agt.

Standard Electrical Test Instruments.

AMMETERS AND VOLTMETERS

FOR DIRECT AND ALTERNATING CURRENTS.

QUEEN'S NEW PORTABLE TESTING SETS

ACCURATELY ADJUSTED. PRICES, $75 TO $125.

Ammeters and Voltmeters Repaired and Recalibrated.

Send for Catalogue 1-66 of Electrical Test Instruments.

QUEEN & CO., PHILADELPHIA.

PHŒNIX GLASS CO

OF PITTSBURGH, PA.

MANUFACTURERS OF A FULL LINE OF

ELECTRIC LIGHT

GLOBES SHADES

BOTH ARC AND INCANDESCENT.

RICH CUT, OPAL, CLEAR, ETCHED, ROUGHED, ETC.

ADAPTED TO ALL SYSTEMS.

729 BROADWAY, NEW YORK.
(COR. WAVERLY PLACE), AND
43 SIXTH AVE., PITTSBURGH, PA.

F. Z. MACUIRE,

ELECTRICAL SECURITIES, ETC.,

18 WALL STREET,

NEW YORK.

ELECTRIC AND STREET RAILWAY PROPERTIES BOUGHT AND SOLD.

THE PATENT FOR THE UNITED STATES for a glowing lamp which has been introduced to the public for years and is acknowledged to be of very favorable construction, is for sale on the most acceptable terms, or royalties may be sold. Please address offers to
No. 9932, care HASSENSTEIN & VOGLER, A. G., Berlin, S. W., 19, Germany.

Norway Iron Frame

ELECTRIC BELL

IS THE

CHEAPEST AND BEST.

Send for Illustrated Circular of Bells and

Other Electrical Goods.

J. ELLIOTT SHAW & CO.,
632 ARCH ST., PHILA.

THE STANDARD OPEN CIRCUIT BATTERIES OF THE WORLD!

For 20 years these Batteries have maintained their superiority over all others and stand to-day unequalled and unapproachable. Refuse to take any cell unless it bears the Trade Mark, "Gonda."

THE LECLANCHÉ BATTERY CO.,
NEW YORK.

MOULDINGS

FOR ELECTRICAL WORK, IN ALL KINDS OF WOOD.

Office and Storehouse: 550 and 552 West 38th Street NEW YORK.

Independent Bung Co.

Large Stock Always on Hand.

Factories: Elizabeth, Wirt Co., W. Virginia, and NEW YORK.

GENUINE TELEPHONES FOR EXPORT.

THE TROPICAL AMERICAN TELEPHONE CO.,

Sole Authorized Exporters to South America, Central America and West Indies.

AMERICAN BELL TELEPHONES, BLAKE TRANSMITTERS AND MAGNETOS.

OLD SWITCHBOARDS AND MAGNETO CALL BELLS

For Sale Cheap and Taken in Exchange for New Ones.

A Platinum Pointed "Chicago" Magneto Telephone Set for $17.00. A New Magneto Telephone Set, complete, like cut, for $15.00. Tropical American Telephone Sets and Universal Long Distance Sets. W. E. Co. Standard Switchboards and New Williams Standard Switchboards in all the different styles and sizes.

PATENTED TELEPHONIC APPARATUS AND SUPPLIES OF ALL SORTS AT LOWEST PRICES.

Send for New Catalogue, Price List and Pamphlet, to

NEW YORK OFFICE, 18 CORTLANDT STREET, or BOSTON OFFICE, 95 MILK STREET.

HOLMES, BOOTH & HAYDENS,

MANUFACTURERS OF

BARE AND INSULATED WIRE,

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K."

PATENT "K. K." LINE WIRE

TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

Agents for the WASHINGTON CARBON CO.,

FACTORIES: WATERBURY, CONN.

NEW YORK OFFICE, 25 Park Place,

THOS. L. SCOVILL, NEW YORK AGENT

AGENTS FOR OKONITE TRADE MARK

Wires, Tape and Cord, Candee Wire.

WHY BUY YOUR SUPPLIES OF THE

SOUTHERN ELECTRICAL SUPPLY COMPANY,

823 LOCUST STREET, ST. LOUIS, MO.

Because their Stock is Complete. Shipments not Delayed. Prices not High.

ELECTRIC LIGHT AND RAILWAY SUPPLIES A SPECIALTY. MOTORS AND DYNAMOS. ALL KINDS OF PORCELAIN GOODS. KEY SOCKETS TO FIT ALL SYSTEMS.

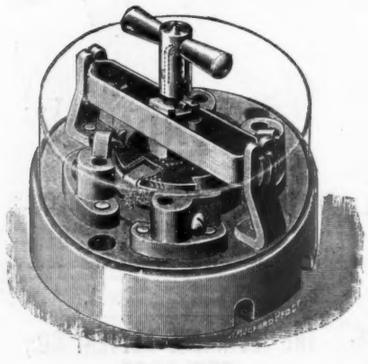
THE PERKINS ELECTRIC SWITCH MFG. CO.

Office, 314 Pearl St. HARTFORD, CONN. Factory, 302 Asylum St.

MANUFACTURERS OF

THE PERKINS INCANDESCENT SWITCHES.

Made with Porcelain Bases only.



No. 1.	Capacity up to	10	Amperes,	Single	Pole.		
No. 2.	"	"	"	15	"	Double	Pole.
No. 3.	"	"	"	30	"	"	"
No. 4.	"	"	"	40	"	"	"
No. 5.	"	"	"	75	"	"	"
No. 6.	"	"	"	100	"	"	"

In preparation.

Rated with continuous current; with alternating current their capacity is increased 50 per cent.

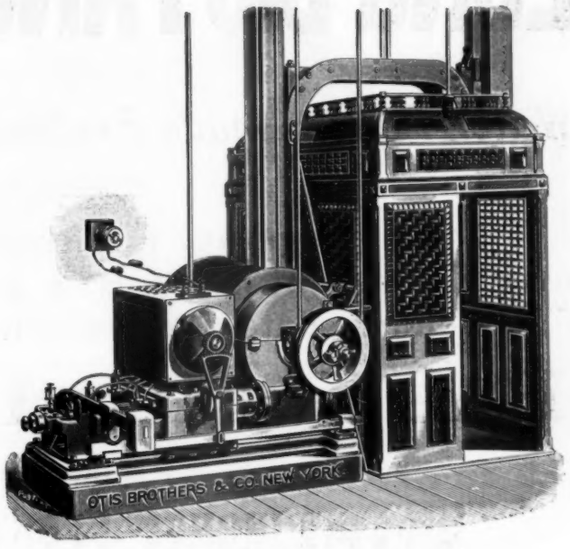
All parts made to gauge and interchangeable. Every Switch Guaranteed. Correspondence Solicited.

Messrs. Otis Brothers & Co., 38 Park Row, New York, the leading passenger and freight elevator builders of the world, have recently produced an Electric Elevator.

It is economical in running expenses, as electricity is only used when the elevator is in operation, and then only in proportion to the load, and is specially adapted to private residences, clubs, hospitals, office buildings and stores. Power can be taken from electric light lines.

If any of our readers are contemplating improvements in their buildings, including elevators, the Otis Electric Elevator should receive every consideration for the very reasons alluded to.

Write for circular, which will be furnished on application.



GRIMSHAW WHITE CORE INSULATED WIRE

Grimshaw Patented White Core WIRES and CABLES.

FIRE, ACID, AND WATERPROOF. GRIMSHAW TAPE.

NEW YORK INSULATED WIRE Co.,

R. E. Gallaher, Secretary. Sole Manufacturers,
J. W. Godfrey, Gen'l Manager.
W. B. Dowse, Treasurer. 649 & 651 BROADWAY, N Y.

IN GENUINE INGOTS & MANUFACTURES LOOK FOR TRADE MARKS

PHOSPHOR-BRONZE

INGOTS, CASTINGS & MANUFACTURES.
THE PHOSPHOR BRONZE SMELTING CO. LIMITED
512 ARCH ST. PHILADELPHIA PA. U.S.A.
ORIGINAL MANUFACTURERS OF PHOSPHOR-BRONZE IN THE UNITED STATES AND OWNERS OF THE U.S. PATENTS.

Phosphor Bronze

THE American Bell Telephone Company,

95 MILK ST., BOSTON, MASS.

This Company owns the Letters Patent granted to Alexander Graham Bell, March 7th, 1876, No. 174,465, and January 30, 1877, No. 186,787.

The Transmission of Speech by all known forms of ELECTRIC SPEAKING TELEPHONES infringes the right secured to this Company by the above patents, and renders each individual user of telephones, not furnished by it or its licensees, responsible for such unlawful use, and all the consequences thereof and liable to suit therefor.

Electric Bells and all About Them.

BY S. R. BOTTONE.

A Practical Book for Practical Men.

WITH MORE THAN 100 ILLUSTRATIONS.

SECOND EDITION. REVISED.

PRICE, - - 50 CTS.

SENT POSTAGE PREPAID TO ANY ADDRESS ON RECEIPT OF PRICE.

Electrical Review,

13 PARK ROW,

P. O. Box 3329. NEW YORK.

POWER

LONG DISTANCE TRANSMISSION

Water-Powers made Profitable. ✳ *Steam Plants Superseded.*

240 horse-power furnished at a point seven miles from Generator over a circuit of No. 0, B. & S. Wire, loss 15 per cent.

Send us data and we will furnish full estimates of

Electrical Apparatus.

WESTINGHOUSE ELECTRIC and MANUFACTURING CO.,

Pittsburgh, Pa., U. S. A.

BOSTON. NEW YORK. CHICAGO. ST. LOUIS. SAN FRANCISCO. CHARLOTTE, N. C.

"Why Don't You"

SEND FOR

OUR NEW CATALOGUE?

DUST PROOF BELLS.
DAISY SPARK COILS.
NEW DINING ROOM PUSH.

We have "kicked" the bottom out on prices.

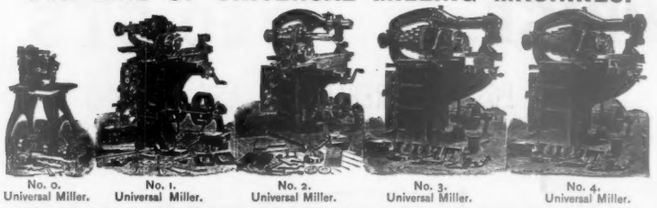
STANLEY & HALL,

32 & 34 Frankfort St., New York City.

HYDRAULIC PRESSES.
ALL VARIETIES.
PUMPS, VALVES, GAUGES AND FITTINGS,
PUNCHES, SHEARS, BUFFING MACHINERY, &c.
WATSON & STILLMAN,
210 EAST 43D STREET, NEW YORK CITY.
Special Attention to Electrical Work.

THE LEHIGH VALLEY
CREOSOTING CO.
WORKS, PERTH AMBOY, N. J.
Office, Foot of Washington Street, JERSEY CITY, N. J.
Creosoted Lumber, Underground Conduits, Telegraph Poles, Piling and Ties Furnished.

OUR LINE OF UNIVERSAL MILLING MACHINES.



No. 0. Universal Miller. No. 1. Universal Miller. No. 2. Universal Miller. No. 3. Universal Miller. No. 4. Universal Miller.

THE CARVIN MACHINE COMPANY,
Manufacturers of, and Dealers in, all kinds of
MACHINERY AND MACHINE TOOLS.
Universal and Plain Milling Machines, Drill Presses, Screw Machines, Hand and Engine Lathes, Planers, Profilers, Chucking Machines,
Gear Cutters, Die and Cutter Grinders, Tapping Machines, Wire-Spring Coilers, Milling Cutters, &c.
Plants for Manufacturers of Sewing Machines & Electrical Goods.
GEAR-CUTTING AND MILLING IN ALL ITS BRANCHES.
Laight & Canal Sts. [Catalogue sent on Application.] NEW YORK.

T. C. WHEATON & CO.,
FLINT GLASS MANUFACTURERS,
Millville, N. J.

INCANDESCENT BULBS,
GLASS TUBING, Etc., Etc.

We make small Battery Jars and Insulators of different kinds for parties furnishing their own mould.

CORRESPONDENCE SOLICITED.

SUBSCRIBE FOR THE ELECTRICAL REVIEW. NOW

Everybody's Hand-Book
—OF—
ELECTRICITY,

By EDWARD TREVERT.

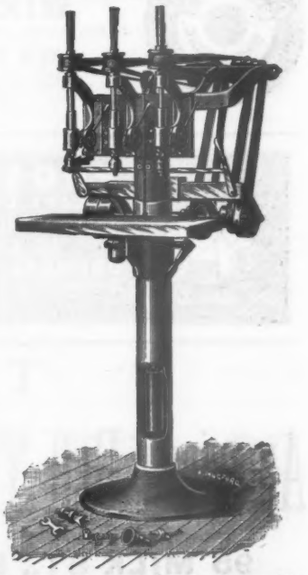
With Glossary of Electrical Terms, and Tables for Incandescent Wiring.

120 PAGES, 50 ILLUSTRATIONS.

Price, Paper, 25 cents, Cloth, $1.00, post paid.

Babier Publishing Co.,
LYNN, MASS.

Sigourney Drills.
IMPROVED.



Sensitive, Strong and Interchangeable.
One, Two and Three Spindles.

GUARANTEED PERFECT.

Send for Price List "B."

The Sigourney Tool Co.,
HARTFORD CONN.

ELECTRIC CONDENSERS
WM. MARSHALL, MANUFACTURER.
Standards a Specialty.
Rooms 3 and 4, University Building, New York.

FARADAY CARBON CO.,
ELECTRIC LIGHT CARBONS, PITTSBURGH. PA.

ELECTRICAL MEASUREMENT

Instruments and Batteries of the Very Highest Grade.

Precision and Constancy, Quality and Finish the Best in the World.

Catalogue of Standard Test Instruments furnished upon application.

THE E. S. GREELEY & CO.,

5 AND 7 DEY ST., NEW YORK.

W. R. ORSTRANDER & CO.

195 & 197 FULTON ST., NEW YORK.

Manufacturers of

SPEAKING TUBES, WHISTLES, ANNUNCIATORS, Electric and Mechanical Bells.

FACTORY, De Kalb Ave., BROOKLYN.

Send for Illustrated Catalogue.

Something New! One, two, three, and four spindle drills for light work.

DRILLS

The most useful patented improvement in drill presses for years is applied.

SENSITIVE

Spindles driven with single, endless belts. Large driving pulleys, tightener and variable speeds provided.

Over 1,000 in use. Buy the **latest** and **best**. Special machinery to order. Catalogue of fine tools free.

Dwight Slate Machine Co.

HARTFORD, CONN.

ROYCE & MAREAN,

DEALERS IN

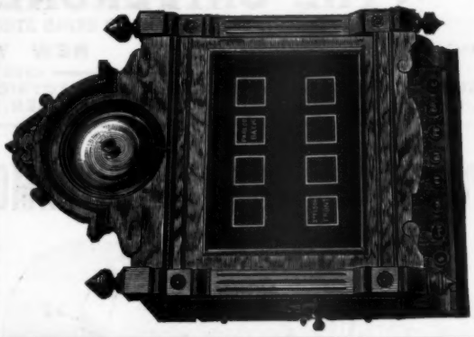
ELECTRICAL APPARATUS,

Telegraph and Telephone Supplies,

No. 1408 Penna. Avenue,

Opp. Willard's Hotel. WASHINGTON, D. C.

Manufacturers



H. E. & C. BAXTER,

18 FULTON STREET,

Brooklyn, N. Y.

WHEN Writing for Catalogues, Information or Prices, **YOU WILL CONFER A FAVOR** on both the **ADVERTISER** and the **PUBLISHER** by mentioning the fact that you saw the advertisement in the *ELECTRICAL REVIEW.*

SUPPLIES FOR ALL SYSTEMS.

Prompt Shipments. Write for Prices.

W. H. GORDON & CO.,

ELECTRIC LIGHT AND POWER SUPPLIES,

SIMPLEX WIRES. *115 Broadway, New York.*

THE

PARKER-RUSSELL MINING & MFG. CO.

MERMOD-JACCARD BUILDING,

Cor. Broadway and Locust St. Rooms 307 and 308.

ST. LOUIS.

SUNLIGHT CARBONS

UNIFORM IN QUALITY, LONG LIFE AND GOOD LIGHT

Washburn & Moen Mfg. Co.,

WORCESTER, MASS.

MAKERS OF

IRON AND STEEL

MANUFACTURERS OF

Iron and Copper Wire for Electrical Purposes.

PATENT GALVANIZED TELEGRAPH & TELEPHONE WIRE,

In Long Lengths, Galvanized by our Patent Continuous Process.

The Standard with all Telegraph and Telephone Companies.

Since the first introduction of the Electric Telegraph Service, our patent wire, expressly manufactured for electric purposes, has filled every requisition as regards strength, evenness of quality, and conductive capacity.

Send for Price Lists and descriptive pamphlets, and "Hand-book of Wire in Electric Service." Sent free on application.

New York Warehouse, 16 CLIFF STREET.

Chicago Warehouse, 107 & 109 LAKE ST.

The Burton Electric Heater for Electric Railway Cars

NO SMOKE! NO GASES! EASILY MANAGED! ECONOMY IN SPACE!

Normal use of current, THREE AMPERES, and the cost of this is in the coal burned at the generating station, which is actually LESS than that of coal burned in a stove on a car.

"They are giving us and the public entire satisfaction."—RICHMOND, VA., U. P. RY. CO.

"The heat is pleasant, sufficient and economical."—MARLBOROUGH, MASS., STREET RY. CO.

"We are much pleased with them, and know of no reason why we shall not continue to use them and recommend them to others."—ST. LOUIS AND EAST ST. LOUIS ELECTRIC RY. CO.

AGENCIES: Equitable Electric Ry. Construction Co., 416-420 Commercial Union Building, Phila., Pa.
Higgins Brothers & Co., 202 Main Street, Buffalo, N. Y.
Electric Merchandise Co., 11 Adams Street, Chicago, Ill.
St. Louis Car Co., St. Louis, Mo.

For Further Information, Address,

THE BURTON ELECTRIC COMPANY, RICHMOND, VA.

GIVES MORE POWER USING LESS WATER THAN ANY OTHER WHEEL.
THE OLD RELIABLE
—LEFFEL—
WATER WHEEL
SEND FOR CATALOGUE.
JAMES LEFFEL & CO.
SPRINGFIELD, O., OR 110 LIBERTY ST., N.Y.

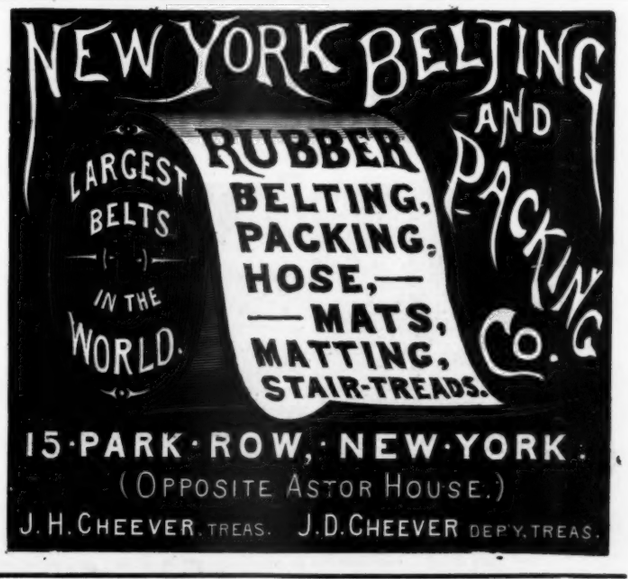
"Prices are low yet quality tells."

A Corliss Engine

well designed and thoroughly built, is the best the world today possesses.

The Lane & Bodley Co., Cincinnati, O., have a high ideal of what their engines should be, and invite their customers to say what they are. If you want an engine and never have seen one of these, write for descriptive circular.

THE LANE & BODLEY CO., CINCINNATI, O.


NEW YORK BELTING AND PACKING CO.
LARGEST BELTS IN THE WORLD.
RUBBER BELTING, PACKING, HOSE,—
—MATS, MATTING, STAIR-TREADS.
15 PARK ROW, NEW YORK.
(OPPOSITE ASTOR HOUSE.)
J. H. CHEEVER, TREAS. J. D. CHEEVER DEP'Y. TREAS.

W. E. WEATHER-PROOF WIRE.

We quote from a letter received from a well-known expert regarding recent tests of the leading weather-proof wires now on the market:

We have tested the samples of wire handed us, and make the following report, the size of the wire, length of pieces and the immersion, being exactly the same in all particulars:

RESISTANCE OF INSULATION.

SAMPLE.	ON IMMERSION.	AFTER 24 HOURS.	48 HOURS.	96 HOURS.	144 HOURS.
No. 1,	28,000 megohms,	130,000 ohms,	80,000 ohms,	27,586 ohms,	25,000 ohms.
" 2,	93 "	960,000 "	320,000 "	10,000 "	1,363 "
" 3,	7 "	900,000 "	800,000 "	500,000 "	272,727 "
" 4,	.46 "	65,000 "	2,856 "	1,600 "	1,000 "
" 5,	3.5 "	83,000 "	0 "	0 "	0 "
" 6,	2.8 "	7,000 "	4,000 "	1,666 "	1,071 "

Sample No. 3 is our improved weather-proof wire, and we guarantee it the equal, if not the superior, of any other wire of like character. PRICES ON APPLICATION.

WESTERN ELECTRIC COMPANY, CHICAGO---NEW YORK.

ARC LAMPS FOR INCANDESCENT CIRCUITS.

THE UNIVERSAL ARC LAMPS. These lamps are intended for direct current circuits, giving a steady and noiseless light, and can be adjusted for circuits having a pressure from 100 to 125 volts, using from eight to nine amperes; when burning two in series, the resistance is coiled about the chimney at the top of each lamp, within which the carbon rod is suspended, thereby rendering any additional resistance unnecessary.

Electric light stations and owners of isolated plants using low potential currents will do well to examine this lamp before purchasing elsewhere, as our claim for the lamp is that it is the best article in the market.

THE UNIVERSAL THEATRICAL ARC LAMP. This lamp is manufactured for stage uses, taking the place of the calcium lights, and can be used wherever constant direct circuits exist; it can be easily handled and has all the effects of the calcium, and the cost of running same being very much cheaper than the old-fashioned method. We are prepared to furnish complete outfits at shortest notice; prices and references on application.

FOR PRICES AND FURTHER INFORMATION, APPLY TO

THE UNIVERSAL ARC LAMP CO.,

Executive Office: 16 AND 18 BROAD STREET. Salesrooms: 49 WEST 22d STREET.

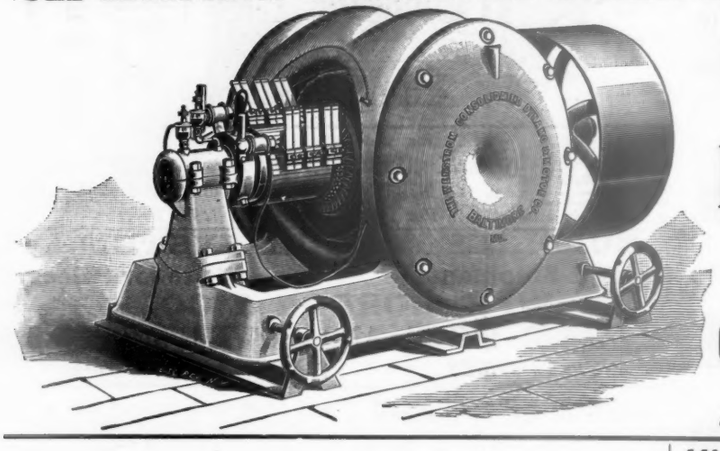
J. H. McCLEMENT, President. NEW YORK. E. S. MENDELS, General Manager.

OR TO

THE ELECTRICAL SUPPLY CO., Chicago, Ill. ST. LOUIS ELECTRICAL SUPPLY CO., St. Louis, Mo. SOUTHERN ELECTRICAL MFG. & SUPPLY CO., Limited, New Orleans, La. WALKER & KEPLER, Philadelphia, Pa. PETTINGELL-ANDREWS CO., Boston, Mass.

THE WENSTROM CONSOLIDATED DYNAMO AND MOTOR CO., OF BALTIMORE, MD.,

MANUFACTURERS OF



ELECTRICAL APPARATUS,

ELECTRIC MOTORS FOR ALL WORK,

Dynamos for Incandescent Lighting.

SPECIAL FEATURES:

High Efficiency. ✳ Slow Speed.

For full information and circulars address,

CHADBOURNE, HAZELTON & CO.,

SOLE SELLING AGENTS FOR U. S.,

416-420 WALNUT ST., PHILADELPHIA.

AGENTS WANTED IN ALL LEADING CITIES.

BUY THE

SCHUYLER APPARATUS

IF YOU WANT THE BEST

Arc Lighting System.

Office and Factory:

MIDDLETOWN,

CONN.

INTERNATIONAL ALUMINUM WORKS,

Manufacturers, under Prof. H. G. Coyle's Processes, of

Aluminum Electroplating Solutions and Anodes.

(PATENTS APPLIED FOR.)

COMPLETE OUTFITS FOR ALUMINUM ELECTROPLATING A SPECIALTY.

County and State Rights Sold. No Royalty.

Offices, 36 & 38 JOHN STREET, NEW YORK, U. S. A.,

And 86 New Street, Birmingham, England.

LABORATORY AND SHOW ROOMS, 53 MAIDEN LANE, NEW YORK.

YOU make a mistake if you don't buy ELECTRICAL SUPPLIES from F. and F., Cleveland, Ohio. SEND FOR THE LATEST "LIST of BARGAINS FOR BELL HANGERS" AND "ROCK BOTTOM" ON MEDICAL BATTERIES. WE UNDERSELL ALL. ADDRESS, Fletcher & Fletcher Electric Co., Cleveland, Ohio. Mention this paper if you want bottom prices.

WELLINGTON

Belt Holder

The simplest, cheapest and handiest device in existence for shifting Dynamo Belts. Please write for circulars to

W. R. SANTLEY & CO.

WELLINGTON, O.

Daniel W. Baker. Cyrus O. Baker, Jr.

BAKER & CO.,

Importers, Melters and Refiners of

PLATINUM,

408, 410, 412 and 414 N. J. R.R. Ave., NEWARK, N. J.

Platinum in sheet and wire, all sizes, and any degree of hardness. Scrap and native platinum purchased

Industries.

A Journal of Engineering, Electricity and Chemistry

— FOR THE —

MECHANICAL AND MANUFACTURING TRADES.

PUBLISHED EVERY FRIDAY.

ANNUAL SUBSCRIPTIONS.	Thick Paper.	Thin Paper.
GREAT BRITAIN, Post Free	$6 00	$6 00
THE UNITED STATES, CANADA and COUNTRIES INCLUDED IN THE POSTAL UNION, Post Free	9 00	8 00
INDIA, CEYLON, STRAITS SETTLEMENTS, CHINA, JAPAN, &c., Post Free	10 75	9 00

SUBSCRIPTIONS PAYABLE IN ADVANCE TO

GEO. CAWLEY, 358 STRAND, LONDON, W. C.

Manchester, 70 Market St.; Glasgow, 93 Hope St.; Yokohama (Japan), 32 Main St.

American Subscriptions to "Industries" are received by the Publisher of the ELECTRICAL REVIEW, 13 Park Row, New York.

NEW AND VALUABLE BOOKS
ON
ELECTRICITY AND ITS APPLICATIONS.

ELECTRICITY AND MAGNETISM.

Practical Electricity.
BY W. E. AYRTON.

A Laboratory and Lecture Course for first year of Students of Electrical Engineering, based on the Practical Definitions of the Electrical Units. **Numerous illustrations. Cloth. Price, $2.50.**

The A. B. C. of Electricity.
BY W. H. MEDOWCROFT.

Giving, in simple language, a general outline of the Science of Electricity. ENDORSED BY THOMAS A. EDISON. **108 pages. Illustrated. Cloth. Price, 50c.**

Elements of Magnetism and Electricity.
BY ANGELL.

With Practical Instructions for the Performance of Experiments and the Construction of Cheap Apparatus. **Numerous illustrations. Cloth. Price, 60c.**

Electricity in Theory and Practice, or the Elements of Electrical Engineering.
BY LIEUT. BRADLEY A. FISKE, U. S. N.

Fifth Edition. **Cloth. 270 pages. 180 illustrations. Price, $2.50.**

THE TELEPHONE.

The Telephone.
BY PROF. A. E. DOLBEAR.

An Account of the Phenomena of Electricity, Magnetism and Sound, as involved in its action, with directions for making a Speaking Telephone. **Cloth. Illustrated. Price, 50c.**

Practical Information for Telephonists.
BY THOS. D. LOCKWOOD.

Revised. New Edition. **192 pages. Cloth. Price, $1.00.**

The Electric Telephone.
BY PROF. GEO. B. PRESCOTT.

Second Edition. Revised and Enlarged. Contains descriptions of new Telephone Inventions and Devices, and includes full descriptions of Hughes' Induction Balance and Sonometer, Boudet's Medical Microphone, Edison's Phonograph, Taintor's Graphophone, the Metropolitan Telephone Central Station, Simultaneous Telephone Transmission on the Same Wire, Installation of Telephone Offices, Construction of Telephone Lines, Aerial and Underground, The Electric Subways in New York, Long-Distance Telephone Lines, and Statistics of the American Bell Telephone Companies. **516 illustrations. 795 pages. Price, $6.00.**

MISCELLANEOUS.

Bell Hangers' Hand-Book.
BY F. B. BADT.

For those Engaged in selling, installing or handling Electric Batteries, Electric Bells, Elevator, House or Hotel Annunciators, Burglar or Fire Alarms, Electric Gas Lighting Apparatus, Electric Heat Regulating Apparatus, etc. **97 illustrations. Cloth. Price, $1.00.**

Electric Bells and All About Them.
BY S. R. BOTTONE.

Giving full details as to the Construction of Batteries, Bells, Pushes, Detectors, etc., the Mode of Wiring, Testing, Connecting, Localizing Faults, in fact, directing careful attention to every case that can present itself to the Electric Bell Fitter. **100 illustrations. 196 pages. Cloth. Price, 50c.**

Electro-Magnets.
BY COUNT DU MONCEL.

The Determination of the Elements of their Construction. **Boards. 122 pages. Price, 50c.**

Electricity in Daily Life.
A Popular Account of the Science and Application of Electricity to every-day uses.

CONTENTS.—Electricity in the Service of Man; The Electric Motor; The Electric Railway; Lighting; The Telegraph; Cable-Laying; Electricity in Warfare—In the Household—Applied to the Human Body. **120 illustrations. Cloth. Price, $3.00.**

Short Lectures to Electrical Artisans.
BY J. A. FLEMING.

A Course of Experimental Lectures delivered to a Practical Audience. **74 illustrations. Cloth. Price, $1.50.**

The Galvanometer and Its Uses.
BY C. H. HASKINS.

A Manual For Electricians and Students. Fourth Edition. Revised. **Morocco. Illustrated. Price, $1.50.**

Dictionary of Electrical Words.
BY PROF. E. J. HOUSTON.

The words, terms and phrases are invariably followed by a short, concise definition, giving the sense in which they are correctly employed. **656 pages. 397 illustrations. Cloth. Price, $2.50.**

Induction Coils.—How Made and How Used.
Boards. Price, 50c.

Electrical Engineers' Pocket Book.
BY H. R. KEMP.

Modern Rules, Formulæ, Tables and Data. **Leather. Price, $1.75.**

Electrical Measurement and The Galvanometer.
BY THOMAS D. LOCKWOOD.

Explaining its Construction and Use. **Cloth. Illustrated. Price, $1.50.**

Lectures on The Electro-Magnet.
BY SILVANUS P. THOMPSON.

Cloth. Price, $1.00.

Electric Light Fitting.
BY J. W. URQUHART.

A Hand-Book for Working Electrical Engineers, Embodying Practical Notes on Installation Management. **Numerous illustrations. Cloth. Price, $2.00.**

POWER.

Electric Motors.
BY S. R. BOTTONE.

A Hand-Book for Amateurs and Practical Men. **Illustrated. Cloth. 132 pages. Price, $1.20.**

The Electric Motor and Its Applications.
BY T. C. MARTIN AND J. WETZLER.

New and Greatly Enlarged Edition. This timely work is the first American book on Electric Motors, and deals exclusively and fully with the modern Electric Motor in all its various practical applications. **300 pages. 275 illustrations. Price, $3.00.**

The Electric Railway of To-day.
BY H. B. PRINDLE.

Fully illustrated. Price, 50c.

The Electric Railway.
BY FRED H. WHIPPLE.

259 pages. 117 illustrations. Price, $1.00.

ELECTRIC LIGHTING.

Elements of Electric Lighting.
BY PHILLIP ATKINSON.

Including Electric Generation, Measurement, Storage and Distribution. Sixth Edition. **104 illustrations, 260 pages. Cloth. Price, $1.50.**

The most complete and comprehensive treatise on Electric Lighting ever published; giving the latest practical facts with the least amount of technicality and mathematical formulæ; with full treatment of the Dynamo, the Storage Battery and the principles of Direct and Alternate Current Lighting.

Dynamo Tenders' Hand-Book.
BY F. B. BADT.

General rules for the care and operation of electric light installations in simple and plain language. Invaluable to dynamo tenders, linemen and others who wish to familiarize themselves with the principles underlying the care and operation of electric light installations. SEND FOR NEW EDITION WITH MOONLIGHT SCHEDULE FOR 1891. **Illustrated. Cloth. Price, $1.00.**

Incandescent Wiring Hand-Book.
BY F. B. BADT.

Containing full instructions for Incandescent Wiring, and complete information concerning Methods of Running Wires, Location of Safety Devices and Switches, Splices, Insulation and Testing for Faults, Wire Gauges, General Electrical Data, Calculating Size of Wires, Wiring of Fixtures, Elevators, Buildings, Isolated and Central Station Plants. New Edition. **Illustrated. Cloth. Price, $1.00.**

The Dynamo.—How Made and How Used.
BY S. R. BOTTONE.

A Book for Amateurs. Sixth Edition. **39 illustrations. 98 pages. Price, $1.00.**

How to Make a Dynamo.
BY ALFRED CROFTS.

A Practical Book for Amateurs. Containing Numerous Illustrations and Detailed Instructions for constructing a small Dynamo. Third Edition. Revised and Enlarged. **Cloth. 104 pages. Price, 80c.**

Incandescent Wiring Table.
And other information for the use of Electric Light Wire Men. **Cloth. Price, 75c.**

Incandescent Electric Lighting.
A Practical Description of the Edison System, to which is added a Description of the Edison Electrolytic Meter, and a paper on the Maximum Efficiency of Incandescent Lamps. **Boards. Price, 50c.**

Alternate Current Machinery.
BY GISBERT KAPP.

Illustrated. Boards. Price, 50c.

Practical Electrical Engineering.
A complete treatise on the construction and management of Electrical Apparatus as used in Electric Lighting and the Electric Transmission of Power. By men eminent in their respective departments. To be completed in 18 monthly parts. Sold only by subscription. **With many hundreds of illustrations. Each part, 75c.**

Electric Light.—Its Production and Use.
BY J. W. URQUHART.

Fourth Edition. Rewritten with large additions. **Numerous illustrations. Cloth. Price, $3.00.**

Practical Dynamo Building for Amateurs.
BY EDWARD WALKER.

How to Wind for any Output. **Numerous illustrations. Boards. Price, 50c.**

Copies of any of the above books, or any electrical work published, will be mailed to any address, postage prepaid, on receipt of price.
Remit by Express or Post Office Money Order, Postal Note, Draft or Registered Letter. Address

ELECTRICAL REVIEW PUBLISHING COMPANY,
P. O. Box 3329. 13 PARK ROW, NEW YORK.

IRON CASTINGS FOR ELECTRICAL PURPOSES.

We cast Dynamo Magnets of a special mixture of iron that gives much better electrical results than ordinary castings. Also, small castings for Electrical Work, and castings, large and small, for all purposes, of finest quality. OUR PRICES ARE LOW. We run four large cupolas constantly, melting about 35 tons daily. Correspondence solicited.

SESSIONS FOUNDRY CO., Bristol, Conn.

THE BILLINGS AND SPENCER COMPANY,

HARTFORD, CONN.

MANUFACTURERS OF BILLINGS' PATENT

PURE COPPER COMMUTATOR BARS

FOR ELECTRIC MOTORS OR GENERATORS,

STEEL COMMUTATOR RINGS AND NUTS,

STEEL WRENCHES AND EYE BOLTS.

DROP FORGINGS OF COPPER, IRON AND STEEL OF ALL DESCRIPTIONS.

Porcelain Electrical Supplies and Specialties,

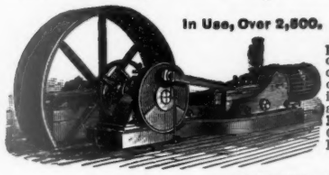
MANUFACTURED BY

EMPIRE CHINA WORKS,

144 & 156 Greene St., GREENPOINT, BROOKLYN, E. D., N. Y.

Our Ware is HARD PORCELAIN, the BODY and GLAZE IDENTICAL, and GUARANTEED NON-CONDUCTIVE for all ELECTRICAL PURPOSES.

New Tangye Buckeye Automatic Cut-off Engines.



In Use, Over 2,500.

25 to 1,000 H. P.

These engines are the combined result of long experience with automatic cut-off regulation, and most careful revision of all details. They are designed and constructed for heavy and continuous duty at medium or high rotative speeds. Highest attainable Economy in Steam Consumption and Superior regulation guaranteed. Self-contained Automatic Cut-off Engines 15 to 200 H. P. for driving Dynamo Machines a Specialty. Illustrated Circulars, with various data as to practical Steam Engine Construction and performance, free by mail

Address BUCKEYE ENGINE CO., Salem, Ohio.

SALES AGENTS:

W. L. SIMPSON, 10 Telephone Building, 18 Cortlandt Street, N. Y.

W. H. ROBINSON, 154 Washington St., Chicago, Ill. Robinson & Cary Company, St. Paul, Minn

---

THE CROCKER-WHEELER PERFECTED MOTORS.

VERY SLOW SPEED—FULL POWER—PERFECT REGULATION—FORGED FIELDS, LET INTO BASE—SELF-OILING BEARINGS—SELF-CENTERING BEARINGS—ALL SIZES—BOTH ARC AND INCANDESCENT—FOR ALL POWER PURPOSES.

Acknowledged by the leading Manufacturing Companies to be

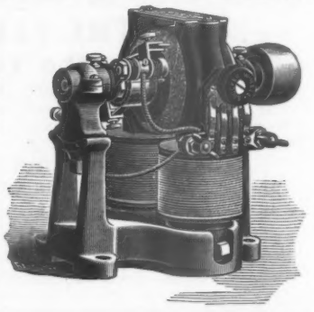
THE MOST PERFECT MOTOR MADE.

Estimates and Plans Furnished for Electric Power Equipment.

CORRESPONDENCE INVITED.

430-432 WEST 14TH STREET, NEW YORK.

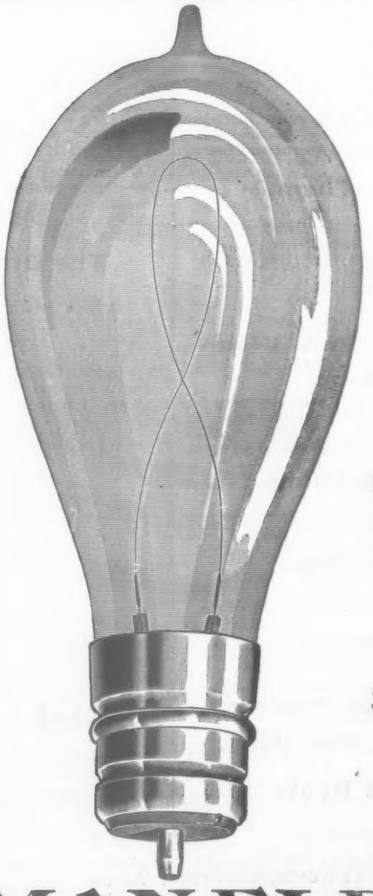
S. S. WHEELER, President. F. B. CROCKER, Vice-Pres't.



INCANDESCENT LAMPS

To Fit any Socket.

Excelling all others in Life, Maintenance of Candle-Power and Efficiency.



Even Diffusion of Light by Twisted Filament.

From 8 Candle-Power to 150 Candle-Power and any Voltage.

THE BEST IS

General Electrical Supplies of Superior Design and Finish.

THE CHEAPEST

Send for Our Catalogue of August 1st, 1890.

SAWYER-MAN ELECTRIC CO.

620 Atlantic Avenue, BOSTON, MASS.

510-534 WEST 23d STREET, NEW YORK.

217 La Salle Street, CHICAGO, ILL.

THE Electric Telephone.

A second REVISED and ENLARGED edition of

The Electric Telephone

BY

PROF. GEORGE B. PRESCOTT,

has just been published, containing 516 illustrations and 795 pages of reading matter. The new edition contains over 200 illustrated descriptions of new telephone inventions and devices, and includes full descriptions of

Hughes' Induction Balance and Sonometer, Boudet's Medical Michrophone, Edison's Phonograph, Tainter's Graphophone, the Metropolitan Telephone Central Station, Simultaneous Telephone Transmission on the Same Wire, Installation of Telephone Offices, Construction of Telephone Lines, Aerial and Underground; The Electric Subways in New York, Long-Distance Telephone Lines, and Statistics of the American Bell Telephone Companies.

Price, = $6.00

SENT TO ANY ADDRESS ON RECEIPT OF PRICE.

ADDRESS:

Electrical Review,

No. 13 PARK ROW,

P. O. Box 3329. NEW YORK.

JUST ISSUED FROM THE PRESS!

WHIPPLE'S Electric, Gas and Street Railway FINANCIAL REFERENCE DIRECTORY

For 1890.

CONTENTS:

List of all Central Electric Light and Power Stations, with Capital Stock, Officers, Systems used, Capacity and Number of Lights in use, Steam Plants, Day Circuits, Kind of Wire and Belts used and Financial Standing.

List of all Isolated Electric Light Plants, with Number and Kind of Lights.

List of all Gas Companies, with Capital Stock, Officers, Price of Gas and Financial Standing, including all Gas Companies operating Electric Light Plants.

List of all Street Railway Companies, with Capital Stock, Officers, Miles of Track, Gauge, Kind of Rail, Number of Cars and Horses, Motive Power, if Electric, Cable or Steam, and Financial Standing.

List of all Telephone Exchanges and Licensed Companies, with Officers and Financial Standing.

Financial Standing of all Manufacturers, Dealers and Agents in the General Electrical World.

Price of all Public Lighting Contracts, with Number and Kind of Lights, Hours Burned, etc.

Rules and Requirements of all the Boards of Fire Underwriters, Insurance Companies, etc.

HANDSOMELY PRINTED AND BOUND.

Sent express paid on receipt of $5; with Monthly Corrections, $6; with Confidential Rate Sheet, $10.

THE FRED H. WHIPPLE CO.,

NEW YORK OFFICE, TEMPLE COURT DETROIT, MICH.

FIELD ENGINEERING COMPANY,

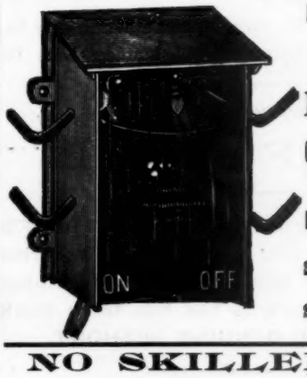
CONSULTING AND CONTRACTING ENGINEERS.

COMPLETE EQUIPMENT OF ELECTRIC STREET RAILWAYS,
DESIGNING AND CONSTRUCTION OF STATIONS, STEAM AND POWER PLANTS.

CORRESPONDENCE SOLICITED.

15 Cortlandt St., New York.

THE E. S. GREELEY & CO.,



Nos. 5 & 7 Dey St., New York

Manufacturers and Importers of and Dealers in

Telegraph, Telephone — AND — Electric Light Supplies

AGENTS FOR

Cleveland Arc Light Cut Outs & Gang Switches

Cleats, Rosettes, Moulding, Pins, Cross-Arms, Brackets, Insulating Tapes.

Rubber, Porcelain and Glass Insulators

WIRES OF ALL KINDS.

Silk & Cotton Covered Flexible Conducting Cord of various sizes for Incandescent Lighting.

Spikes, Pole Steps, Lag Screws, Drive Screws, Turn Buckles, Etc.

NO SKILLED ENGINEER.

The Shipman Automatic Steam Engine.

1, 2, 4, 6 and 8 horse-power Stationary and Marine.

The automatic action of fuel and water supply and unvarying speed of the SHIPMAN make it the most desirable power for small ISOLATED ELECTRIC PLANTS on the market, and we desire to call the particular attention of prospective users of Dynamos, either for lighting or electroplating, to our engine.

ST. PAUL, MINN.,
December 29, 1888.

SHIPMAN ENGINE CO.,

Gentlemen: Replying to yours of the 18th, would say that I am very much pleased with the working of my engine (2 horse-power). Have run two eight-light incandescent dynamos, one of two lights, printing press, grindstone, emery wheel, and No. 6 Barnes engine lathe, with 60 pounds steam, engine running 375 revolutions per minute. Boiler steams very freely and engine runs without noise.

Respectfully,
A. M. P. COWLEY.

SEND FOR CATALOGUE.

SHIPMAN ENGINE CO.,

236 Summer Street, BOSTON, MASS.

FORT WAYNE ELECTRIC COMPANY,

FORT WAYNE, IND.

MANUFACTURERS OF THE

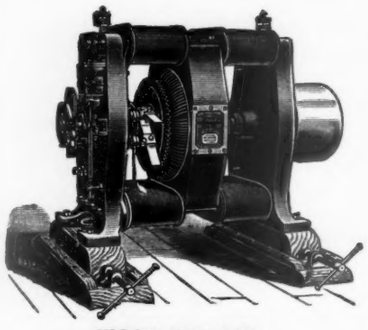
Slattery Induction System of Long Distance Incandescent Lighting

AND THE

Wood Automatically Regulating

ARC DYNAMO AND LAMPS.

Main Office, FORT WAYNE, IND.



WOOD DYNAMO.

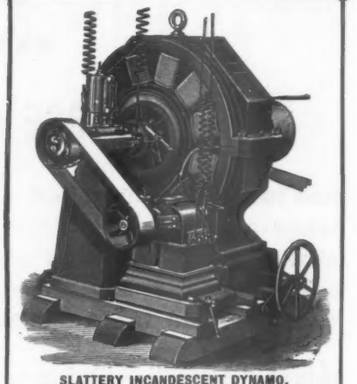
BRANCH OFFICES:

NEW YORK, -	115 Broadway.
PHILADELPHIA,	907 Filbert Street.
PITTSBURGH, PA.,	533 Wood Street.
CHICAGO, - -	185 Dearborn Street.
SAN FRANCISCO,	35 New Montgomery Street.

TORONTO, CANADA, 138 King Street.
MEXICO, F. Adams' Successors, City of Mexico.

FACTORIES:

FORT WAYNE, - - - -	INDIANA.
BROOKLYN, - - - -	NEW YORK.



SLATTERY INCANDESCENT DYNAMO.

NATIONAL ELECTRICAL MFG. CO.

14 & 16 Vesey Street, New York, N. Y.

SUCCESSORS TO

Electrical Dept., New Haven Clock Co., Microphone Carbon Battery Co., Crowdus Dry Battery, Porter Electric Messenger Co., Splitdorf Wire Co.

IF YOU WANT A PERFECT WIRE, USE THE

SPLITDORF WIRE.

THIS Company owns all of H. SPLITDORF'S CELEBRATED PATENTS for covering all sizes of wire. All wire manufactured under these patents has this trade mark affixed. NONE GENUINE WITHOUT.

The advantages of the SPLITDORF WIRE over any other insulated wire are:

1st. A perfect insulation is obtained.

2d. All oxidation is prevented, and the wire and its conductivity are preserved against the deleterious effect of dampness.

3d. The outer covering (whether silk or cotton) adheres fast to the wire, and does not slip or unwind from the ends.

4th. A greater length of wire prepared under the SPLITDORF patents can be wound in a given space than wire insulated by any other process known.

5th. Since the strength of a magnet depends upon the number of its convolutions, SPLITDORF INSULATED WIRE will produce a much stronger magnet of a given size than any other wire in the market.

Wire covered with cotton by the SPLITDORF patents is fully equal in every respect to wire covered with silk under any other process, while SPLITDORF silk covered wire is far superior to the ordinary silk covered wire, in that so much finer silk can be used and such a decrease in bulk effected.

Having increased our plant ten-fold, we shall be able to furnish wire at short notice. We manufacture all grades of wire, Magnet, Annunciator, Office, etc., etc.

SEND FOR OUR GENERAL CATALOGUE, ILLUSTRATED IN COLORS.

The "Standard" Instruments for Electric Testing.

VOLTMETERS AND AMMETERS FOR

CENTRAL STATION, LABORATORY & BATTERY WORK.

WE GUARANTEE OUR INSTRUMENTS CORRECT, AS EACH INSTRUMENT IS CAREFULLY CALIBRATED BEFORE LEAVING THE LABORATORY, AND WE FURTHER GUARANTEE TO KEEP THEM IN CALIBRATION IF SENT TO US FOR THAT PURPOSE.

TO SUM IT UP.

OUR "STANDARD" VOLTMETERS AND AMMETERS FILL THE LONG FELT WANT FOR A LINE OF INSTRUMENTS COMBINING ACCURACY, BEAUTY AND, MORE ESPECIALLY, REASONABLENESS IN PRICE.

WE SOLICIT YOUR CORRESPONDENCE.

A SPECIAL LINE OF VOLTMETERS FOR RAILWAY WORK AT LOW FIGURES.

PRICES QUOTED ON APPLICATION.

STANDARD ELECTRIC SUPPLY CO.,

180 SUMMER STREET, BOSTON, MASS., SOLE AGENTS.

DETROIT ELECTRICAL WORKS.

The Rae Electric Railway System.

HIGHEST EFFICIENCY

The Only System Employing a Single Motor of Large Horse-Power, with Noiseless Gearing connecting both Axles.

STATIONARY MOTORS OF ALL SIZES.

CORRESPONDENCE SOLICITED —AND— ESTIMATES FURNISHED.

1427 to 1457 WOODWARD AVENUE, DETROIT.

THE

Empire City Electric Co.

15 and 17 DEY STREET,

NEW YORK.

Cut-Outs and Rosettes.

Main Line and Branch Blocks.

PRICES ON APPLICATION.

THE BERLIN IRON BRIDGE CO.

The above illustration is taken direct from a photograph of an iron bending shed built by us for The Newport News Ship Building & Dry Dock Company, at Newport News, Va. The building is entirely of iron, and is, therefore, indestructible by fire. The building shown at the right of the illustration—the iron frame only—is a two story ship shed built by us for the same Company. At the time the photograph was taken, the bending shed was completed, but only the framework of the ship shed had been erected.

SEND FOR OUR ILLUSTRATED CATALOGUE.

Office and Works: East Berlin, Conn.

AGENCIES:

Wm. Payson, San Antonio, Tex. M. B. Grant, Enterprise, Miss.
W. E. Stearns, Omaha, Neb. A. M. Rawn, Dayton, Ohio.

A. B. C. OF ELECTRICITY.

BY WM. H. MEADOWCROFT,

giving, in simple language, a general outline of the science of electricity.

Endorsed by THOS. A. EDISON.

PRICE, 50 CENTS.

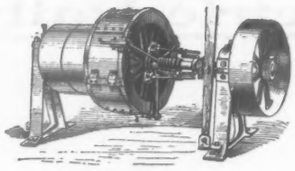
108 pages, illustrated, cloth. Sent, postpaid, to any address on receipt of price.

ELECTRICAL REVIEW,

P. O. Box 3329. 13 Park Row, New York.

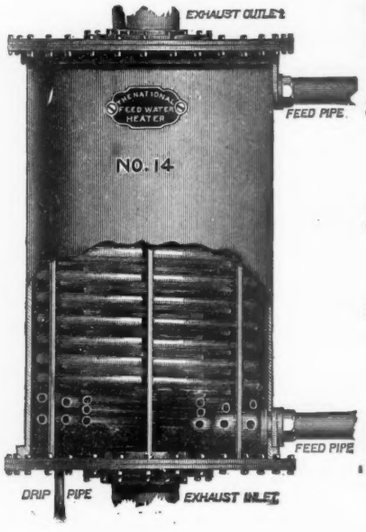
T. M. FOOTE REGULATOR CO.

UNIFORM SPEED FOR
DYNAMOS,
STREET RAILROAD GENERATORS,
AND ALL CLASSES OF
MACHINERY.



Water Power Made Equal to Steam.

OFFICE:
271 FRANKLIN STREET, BOSTON, MASS.
WESTERN AGENTS:
CHANDLER & LITTLEFIELD, Marine Building, Chicago, Ill.



The National Feed-Water Heater.

Over 300,000 Horse Power in use in the United States.

200 ELECTRIC LIGHT STATIONS SUPPLIED.

PRICES LOW. SATISFACTION UNIVERSAL,

Seventeen sizes Manufactured, 8 to 2,000 Horse Power Capacity. Heats the Water for the Boilers up to 206° to 212° F.

SEND FOR LIST OF USERS AND EXAMINE FOR YOURSELF.

THE NATIONAL PIPE BENDING CO.,

84 River Street, New Haven, Conn.

UNITED ELECTRIC TRACTION COMPANY,

EXECUTIVE OFFICES, 115 BROADWAY, NEW YORK.

AGENCIES:

926 Drexel Building, Philadelphia. 111 Water Street, Pittsburgh, Pa. 456 Rookery Building, Chicago.

Electric Railways and Power Stations,

STATIONARY MOTORS, STORAGE BATTERIES.

DYNAMOS, 1 to 250 H. P. MOTORS, ½ to 100 H. P.

WORKS, JERSEY CITY, N. J.

GOOD GOODS. PROMPT SHIPMENTS. LOW PRICES.

GATE CITY ELECTRIC COMPANY,

Special Agents,

Manufacturers and Dealers in

Telegraph, Telephone, Electric Light

— AND —

GENERAL ELECTRICAL SUPPLIES.

OKONITE
TRADE MARK

GLOBES AND SHADES,

Glass and Porcelain Insulators

— AND —

Incandescent Lamps.

AND CANDEE WIRES, CABLES, TAPE AND TUBING.

522 DELAWARE STREET, - - - - - - - - KANSAS CITY, MO.

THE

THOMSON-HOUSTON ELECTRIC CO.

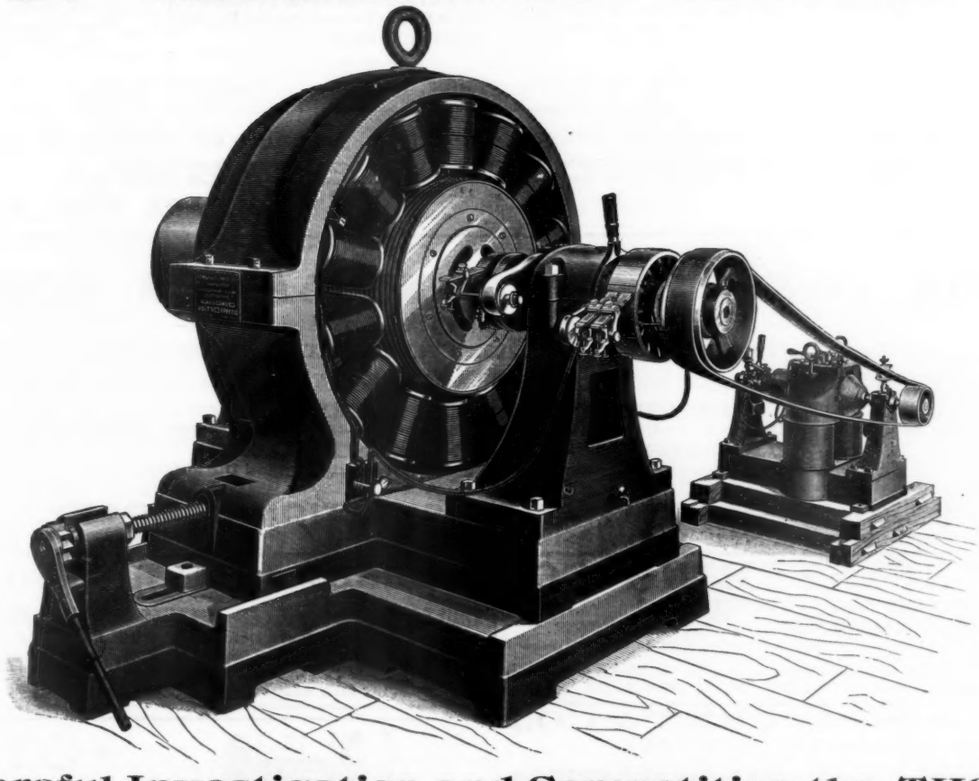
MANUFACTURER OF

DYNAMOS, LAMPS, TRANSFORMERS,

AND ALL NECESSARY APPLIANCES FOR

INCANDESCENT LIGHTING

BY ALTERNATING CURRENT.



After Careful Investigation and Competition the THOMSON-HOUSTON SYSTEM was adopted by the

UNITED STATES GOVERNMENT

For Lighting Officers' Quarters and Public Buildings at the Navy Yard, Mare Island.

For Catalogues and Information, Address,

THOMSON-HOUSTON ELECTRIC CO.,

620 Atlantic Avenue, Boston, Mass.
405 Sibley Street, St. Paul, Minn.
115 Broadway, New York City.
15 First Street, San Francisco, Cal.
266 First Street, Portland, Ore.
831 New York Life Building, Kansas City, Mo.
148 Michigan Avenue, Chicago, Ill.
Wall and Loyd Streets, Atlanta, Ga.
215 West Fourth Street, Cincinnati, O.
1333 F Street, Washington, D. C.
New Kirk Building, Syracuse, N. Y.
509 Arch St., Philadelphia, Pa.

BARNES' FOOT POWER LATHES.

Barnes' Foot Power Lathes, 16 different styles and sizes, suitable for all classes of work from the Blacksmith to the Jeweler. There is no application of foot power equal to the Patent Velocipede, used with these lathes. Thousands of them are in practical use in the shops of metal and wood workers.

L. G. Woolley, of Grand Rapids, Mich., says: "I wish to say that I have owned and used two of your No. 6 foot power lathes now about five years. The tools have been put to hard and continuous work in my laboratory, and it gives me pleasure to say that up to this time, no repairs of any kind whatever have been needed. Indeed the tools are all and more than what you claim for them. My time is devoted exclusively to invention and experimental work in electricity. In doing this it is necessary to have accuracy, and wide range of adaptation to different work. Your excellent lathes and superb foot power is all that could be desired by any one in need of a first-class tool."

Send for catalogue of wood and metal workers' outfits.

W. F. & JOHN BARNES CO., No. 419 Ruby St., Rockford, Ill.

DEPARTMENT OF ENGRAVING, ELECTRICAL REVIEW, 13 PARK ROW NEW YORK.

ELECTRICAL ENGRAVING, A SPECIALTY.

SEND FOR ESTIMATES OF CATALOGUE & ELECTRICAL *ENGRAVING, OF EVERY DESCRIPTION.*

NEW ELECTRICAL BOOKS.

PRACTICAL ELECTRIC NOTES AND DEFINITIONS.

Designed for the Use of Engineering Students and Practical Men.

BY

W. PERREN MAYCOCK.

TOGETHER WITH

The Rules and Regulations to be observed in Electrical Installation Work.

PRICE, - - - .60 CENTS.

PRACTICAL ELECTRICS.

A UNIVERSAL HANDY BOOK

ON

Everyday Electrical Matters,

INCLUDING

CONNECTIONS, ALARMS, BATTERIES, CELLS, CARBONS, Etc., Etc.

A Convenient Reference Book for those having Electric Bells, Telephones or Electric Lights, in their Houses.

PRICE, - - - 75 CENTS.

EXPERIMENTAL SCIENCE.

BY

GEO. M. HOPKINS.

TREATING THE VARIOUS TOPICS OF PHYSICS IN A POPULAR AND PRACTICAL WAY. IT DESCRIBES THE APPARATUS IN DETAIL AND EXPLAINS EXPERIMENTS IN FULL TO ENABLE STUDENTS TO MAKE APPARATUS WITHOUT MUCH EXPENSE.

PRICE, - - - - $4 00.

MODERN VIEWS OF ELECTRICITY.

BY

OLIVER J. LODGE.

Explaining without Technicalities and Illustrating by Mechanical Models and Analogies, the Position of Thinkers on Electrical Subjects at the Present Time.

PRICE, - - - - $2 00.

Copies of any of the above works sent, postage prepaid, on receipt of price.

ELECTRICAL REVIEW,

P. O. Box 3329. **13 PARK ROW, NEW YORK.**

THE TUBES OF THE INTERIOR CONDUIT AND INSULATION COMPANY

ARE ESPECIALLY APPLICABLE TO

ELECTRIC RAILWAY REQUIREMENTS.

A Simple Solution of the Wiring Problem for Public Buildings, Residences, Factories, Station Work, Cars, Underground Feeders, and all places where insulation is required.

INTERIOR CONDUITS.

Endorsed by the Leading Electricians, Electric Light Companies, Wiring Contractors, Architects, Builders and Boards of Fire Underwriters.

UNDERGROUND CONDUITS

Are equally successful, and afford Cheapness, High Insulation and Durability.

For Catalogue, Price List and General Information, address

INTERIOR CONDUIT AND INSULATION COMPANY,

16 and 18 BROAD STREET, NEW YORK CITY. *EDWARD H. JOHNSON, Prest.*

POND ENGINEERING CO.,

ENGINEERS AND CONTRACTORS.

Complete Steam Plants for Electric Light and Power.

Engines, Boilers, Furnaces, Grates, Heaters, Pumps, Injectors, Pipe Work, Belting, etc., designed with special reference to the HIGHEST EFFICIENCY.

Our Extended Experience Enables us to Guarantee Satisfaction. Send for New Illustrated Pamphlet.

ST. LOUIS, CHICAGO, KANSAS CITY, OMAHA, DALLAS AND SEATTLE.

Shultz Belting Company,

MANUFACTURERS OF

SHULTZ PATENT FULLED LEATHER BELTING AND LACE LEATHER.

Office and Factory: Cor. Bismarck and Barton Sts., St. Louis, Mo.

Our Belting is made of leather tanned on the surface only; the interior (which is the fiber and strength of the hide) is not tanned but rawhide fulled and softened by our patent process. Our Belting is more pliable, hugs the pulley better, transmits more power than any other, and is the only perfect ELECTRIC LIGHT BELT MADE. Agents in all cities. Send for trial belt.

CHARLES R. VINCENT & CO.,

15 CORTLANDT STREET, NEW YORK,

Ball High Speed Automatic Cut-off Engines

MANNING VERTICAL TUBULAR BOILERS,

Complete Steam Plants Furnished and Erected.

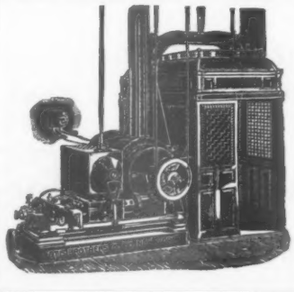
WILLIAMS & POTTER,

15 CORTLANDT ST., NEW YORK.

Engineers & Contractors,

GENERAL AGENTS,

STRAIGHT LINE ENGINES



OTIS ELECTRIC ELEVATOR,

FOR

Stores, Office Buildings and Residences.

OTIS BROTHERS & CO.,

38 PARK ROW, NEW YORK.

JULIEN STORAGE BATTERIES

MANUFACTURED BY

The Consolidated Electric Storage Company,

Exclusive Licensee of the Brush and Julien Storage Battery Patents.

FOR AGENCIES AND LICENSES, ADDRESS THE COMPANY,

120 Broadway, N. Y.

FOR BATTERIES, ADDRESS THE COMPANY,

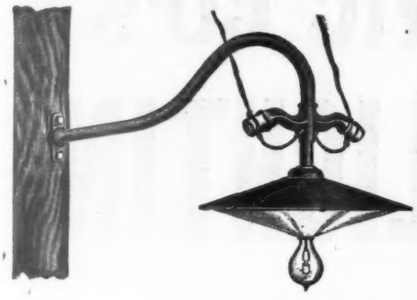
926 Drexel Building, Philadelphia, Pa.

THE NATIONAL CARBON CO.

CLEVELAND, OHIO.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.



INCANDESCENT LAMPS FOR ARC LIGHT CIRCUITS

ESPECIALLY DESIRABLE FOR STREET AND STORE LIGHTING.

A NECESSITY TO EVERY LIGHTING CO. ✳ ALL OUTSIDE PARTS OF INSULATING MATERIAL.

INCANDESCENT LAMPS FOR MULTIPLE CIRCUITS

ANY VOLTAGE. CAPPED FOR ANY SOCKET.

BERNSTEIN ELECTRIC CO.

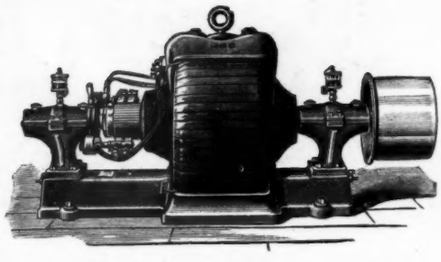
620 ATLANTIC AVENUE, BOSTON, MASS.

"C. & C." ELECTRIC MOTORS.

The only Motors in which the magnetic circuit forms a perfect circle around the centre of the armature shaft. Thus making the most compact and efficient form of machine that can possibly be devised.

One-eighth horse-power to 50 horse-power in stock.

OVER 10 000 MOTORS IN ACTUAL OPERATION.



FAN OUTFITS.

Electric Blowers for Ship Ventilation.

MOTORS FOR HOISTS AND MINING TRAMWAYS.

Equipment of Machine Shops, Printing Offices, Factories and Entire Buildings, with Electric Power.

New England Office, 63 Oliver Street, Boston.
Philadelphia " 38 South Fourth Street.
Chicago " Phenix Building.

"C. & C." ELECTRIC MOTOR COMPANY,

402 & 404 Greenwich Street, New York.

BROWNLEE & CO.,

DETROIT, MICH.

CEDAR POLES

For Electric Purposes.

THE LARGEST STOCK AND QUICKEST SHIPMENTS.

☞ Manufacturers of the Celebrated Octagonal Red Pine Poles for Electric Railways and Electric Lighting; also Manufacturers of Cross-Arms and Pins.

THE **CLARK**

ARC LIGHTING SYSTEM

Is the Safest and Most Economical in the United States.

Manufactured by the CLARK ELECTRIC CO., 192 Broadway, N. Y.

EUREKA TEMPERED COPPER COMPANY,

NORTH EAST, PA.,

ONLY MANUFACTURERS OF PURE COPPER TEMPERED FOR

Brush Copper, Commutator Bars, Copper Wire, Gear Pinions, Bearings, Trolley Wheels.

WESTERN SALES OFFICE: 225 DEARBORN STREET, CHICAGO.

EASTERN SALES OFFICE: 35 BROADWAY, NEW YORK.

"The Electric Railway of To-Day."

—BY—

H. B. PRINDLE,

OF BOSTON.

HANDSOMELY ILLUSTRATED.

THE SUBJECT POPULARLY TREATED.

An Able and Interesting and Timely Publication.

PRICE, 50 CENTS.

ADDRESS:

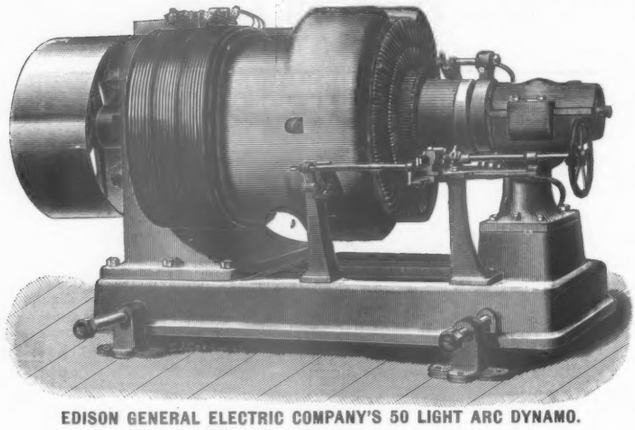
ELECTRICAL REVIEW,

13 Park Row, New York.

EDISON

GENERAL ELECTRIC CO'S

SYSTEM OF ARC LIGHTING.



EDISON GENERAL ELECTRIC COMPANY'S 50 LIGHT ARC DYNAMO.

THE GENERATOR,

EXCELLENT IN ELECTRICAL DESIGN.

Simple and Strong Mechanically.

Large, Well Balanced, Well Ventilated Armature.

Sectional Field Windings.

Regulation Automatic, Regulator Simple and on the Machine.

No Extra Circuits, No Wall Resistance.

ARC LAMPS,

NEW IN DESIGN.

1,200 and 2,000 Candle-Power. Lamps for 7 or 14 hours Continuous Burning as Desired.

ADDRESS NEAREST DISTRICT OFFICE.

MAIN DISTRICT OFFICES:

CANADIAN DISTRICT, BANK OF COMMERCE BUILDING, TORONTO, CAN.
CENTRAL DISTRICT, RIALTO BUILDING, CHICAGO, ILL.
EASTERN DISTRICT, EDISON BUILDING, BROAD STREET, NEW YORK.
NEW ENGLAND DISTRICT, 38 PEARL STREET, BOSTON, MASS.
PACIFIC COAST DISTRICT, EDISON BUILDING, 112 BUSH ST., SAN FRANCISCO, CAL.
PACIFIC NORTHWEST DISTRICT, FLEISCHNER BUILDING, PORTLAND, ORE.
ROCKY MOUNTAIN DISTRICT, MASONIC BUILDING, DENVER, COLO.
SOUTHERN DISTRICT, 10 DECATUR STREET, ATLANTA, GA.

"ELECTRICITY IN DAILY LIFE."

A POPULAR ACCOUNT

— OF THE —

APPLICATIONS OF ELECTRICITY

TO EVERY DAY USES.

TASTEFULLY BOUND

— AND —

HANDSOMELY ILLUSTRATED.

A HANDSOME HOLIDAY GIFT BOOK for the Electrical Fraternity to present to their friends or to buy for themselves.

PRICE, $3.00.

Address,

ELECTRICAL REVIEW PUBLISHING CO.,

13 Park Row, New York.

THE MOSHER ARC LAMP,

— FOR —

Direct Incandescent Circuits, is Phenomenal, Outstripping in ECONOMY, BRILLIANCY, STEADINESS, SIMPLICITY and General Efficiency, all others.

BURNS SINGLY OR IN SERIES.

ONE LAMP OF STANDARD CANDLE-POWER USES FOUR TO FIVE AMPERES, AND TWO IN SERIES, EIGHT TO TEN.

Warranted in every respect. Please state System and Voltage.

FOR PRICES AND FURTHER PARTICULARS, ADDRESS,

MOSHER ARC LAMP COMPANY,

125 ONTARIO STREET, CHICAGO, ILL.

THE WESTON STANDARD

VOLTMETERS AND AMMETERS.

These instruments are the most accurate, reliable and sensitive, portable instrument ever offered. A large variety of ranges to meet the requirements of all kinds of work.

SEND FOR ILLUSTRATED CATALOGUE.

Address,

WESTON ELECTRICAL INSTRUMENT CO.,

Office and Factory 114 & 116 William St., NEWARK, N. J.

NATIONAL ELECTRICAL MFG.CO.

14 & 16 Vesey Street, New York, N. Y.

SUCCESSORS TO

Electrical Dept., New Haven Clock Co., Microphone Carbon Battery Co., Crowdus Dry Battery, Porter Electric Messenger Co., Splitdorf Wire Co.

IF YOU WANT A PERFECT WIRE, USE THE

SPLITDORF WIRE.

THIS Company owns all of H. SPLITDORF'S CELEBRATED PATENTS for covering all sizes of wire. All wire manufactured under these patents has this trade mark affixed. NONE GENUINE WITHOUT.

The advantages of the SPLITDORF WIRE over any other insulated wire are:

1st. A perfect insulation is obtained.

2d. All oxidation is prevented, and the wire and its conductivity are preserved against the deleterious effect of dampness.

3d. The outer covering (whether silk or cotton) adheres fast to the wire, and does not slip or unwind from the ends.

4th. A greater length of wire prepared under the SPLITDORF patents can be wound in a given space than wire insulated by any other process known.

5th. Since the strength of a magnet depends upon the number of its convolutions, SPLITDORF INSULATED WIRE will produce a much stronger magnet of a given size than any other wire in the market.

Wire covered with cotton by the SPLITDORF patents is fully equal in every respect to wire covered with silk under any other process, while SPLITDORF silk covered wire is far superior to the ordinary silk covered wire, in that so much finer silk can be used and such a decrease in bulk effected.

Having increased our plant ten-fold, we shall be able to furnish wire at short notice. We manufacture all grades of wire, Magnet, Annunciator, Office, etc., etc.

SEND FOR OUR GENERAL CATALOGUE, ILLUSTRATED IN COLORS.

CENTRAL ELECTRIC CO.

General Dealers in

ELECTRICAL SUPPLIES.

GENERAL WESTERN AGENTS FOR

OKONITE

TRADE MARK.

AND

IMPROVED + CANDEE + WIRES.

These Wires are so well known to the Trade that CONVINCING arguments are not necessary. Everybody knows what they are. Send your orders to us when you want the greatest moisture and acid-proof, or the King of Weather-proof Wires.

CENTRAL ELECTRIC CO., 116 & 118 Franklin St., CHICAGO.

CONNECTED BY PRIVATE WIRE WITH POSTAL TELEGRAPH CABLE CO.

CARBON PLATES & CARBON BATTERIES

ELECTRIC LIGHT CARBONS.

MADE FROM NATURAL GAS BY PATENTED PROCESS.

— ADDRESS —

SOLAR CARBON & MANUFACTURING CO.,

95 & 97 FIFTH AVE., PITTSBURGH, PA.

NEW ENGLAND BUTT CO.,

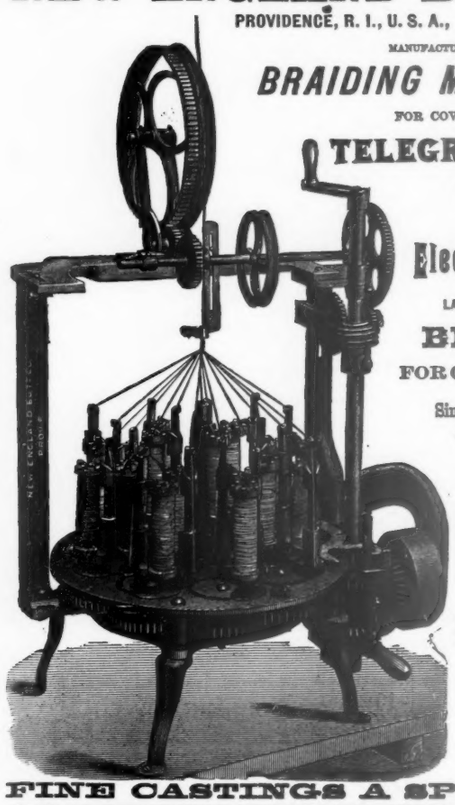
PROVIDENCE, R. I., U. S. A.,

MANUFACTURERS OF

BRAIDING MACHINERY

FOR COVERING

TELEGRAPH, TELEPHONE AND **Electric Light Wire,**



LARGE SINGLE AND DOUBLE

BRAIDERS

FOR COVERING CABLES,

Single, Double and Triple

WINDERS,

Horizontal and Upright

Taping Machines,

Cabling Machines,

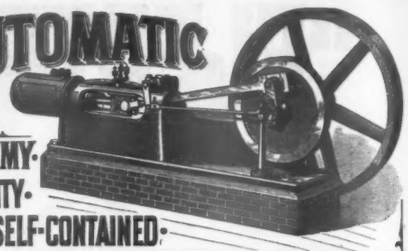
Measuring Machines,

Stranding Machines,

Etc., Etc.

FINE CASTINGS A SPECIALTY.

THE PRICE AUTOMATIC



GUARANTEED ECONOMY · REGULATION · DURABILITY · SIMPLICITY · SELF-CONTAINED ·

8 TO 300 H.P. PAIR & TANDEM COMPOUNDS.

THE JOHN T. NOYE MFG CO. BUFFALO, N.Y.

FAIRBANKS, MORSE & CO., Western Representatives, Chicago, St. Louis, Kansas City, Omaha, Denver, St. Paul

ALBERT FISHER, 89 Liberty Street, New York, Eastern Agent.

DO YOUR LAMPS BURN OUT TOO SOON?

YOU BUY THE WRONG KIND!

USE THE

"A. B. C." INCANDESCENT LAMP.

SUPERIOR QUALITY. MODERATE PRICE.

SOCKETS. TRADE A.B.C. MARK SWITCHES.

AMMETERS. CUT-OUTS. VOLTMETERS.

"A. B C." Insulating Tape.

WIRE.

ALEXANDER, BARNEY & CHAPIN,

TELEPHONE BUILDING,

20 Cortlandt Street, NEW YORK.

AN EXCELLENT ARTICLE.

The P.&B. TRADE P. & B. MARK REGISTERED INSULATING TAPE.

MANUFACTURED ONLY BY

THE STANDARD PAINT CO.,

RALPH L. SHAINWALD, Pres., 59 MAIDEN LANE, NEW YORK.

THE HOLTZER-CABOT ELECTRIC COMPANY

MANUFACTURERS OF

ALL KINDS OF ELECTRICAL SUPPLIES,

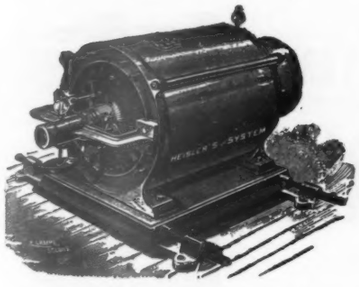
OFFICE:
111 ARCH STREET, BOSTON.

FACTORY:
BROOKLINE, MASS.

HEISLER SYSTEM LONG DISTANCE SERIES INCANDESCENT ELECTRIC LIGHTING

Awarded the Highest Distinction, a Gold Medal, at the Paris Exposition, 1889.

UNEQUALLED FOR DISTRIBUTION OVER WIDE AREAS.



Specially adapted for Street, Commercial and General Illumination from Central Stations. Plant may be located where Power can be secured Cheapest, even if Miles Distant from the Lighting. Safety, Reliability and Financial Success fully Demonstrated. Plan of Wiring the Simplest, Cheapest and Most Efficient. Strictly Series. Lamps, 10 to 100 Candle Power. Long Life without Blackening. Dynamo Self-Contained and Automatic.

SEND FOR CIRCULARS. **CORRESPONDENCE SOLICITED.**

HEISLER ELECTRIC LIGHT CO., Drexel Building, PHILA., PA.

PATENTED NOVEMBER 11, 1888.

The "Special" Gethins Battery,

FOR CHARGING STORAGE CELLS.

Manufactured by the Gethins Electrical Manufacturing Company,

620 ATLANTIC AVENUE, BOSTON, MASS.

Anticipating the unlimited uses to which storage batteries can be applied, the Gethins Electrical Manufacturing Company has perfected and placed on the market a GRAVITY battery which is unsurpassed for the purpose of charging storage cells at a minimum cost, and which involves no trouble in the use of the same, thus enabling any person to handle the battery.

The field for the application of these batteries in connection with storage cells for motive purposes, where powerful chemical batteries or dynamos are impracticable because of expense and labor involved, or distance from an electric plant—is vast. They are already used to operate sewing machines, rotary fans, phonographs, electric pianos and various other appliances, and they can be employed for innumerable purposes in the house, office and factory. A further important and extensive application of the same will be in the furnishing of electricity for running small candle-power lights.

Attention is called to the following testimonial:

BOSTON, Sept. 11, 1890.

B. M. MESERVEY, General Manager Gethins Electrical Manufacturing Co., 620 Atlantic Avenue, Boston, Mass.:

DEAR SIR: Your favor of yesterday at hand. In regard to the battery which we are using, would say that it is doing all the work you claim. We are more than pleased with it, and it is the only "primary" at the present time which we consider satisfactory for such work. We have been using this battery for the past four or five months, and we find that four of the cells connected with a 15 "M" accumulator storage battery will give sufficient power to run our machine with great success. We should advise all persons having occasion to use gravity cells in connection with their storage battery to use yours by all means, as it is surely the most economical and gives the best satisfaction of any which we have ever tried.

We are, yours very truly,

NEW ENGLAND PHONOGRAPH CO., by AUG. N. SAMPSON, General Manager.

Price of Battery per cell, ready for shipment.....$1.35 | Price of Battery per cell, with chemicals, ready for shipment.....$1.80

The Gethins Electrical Manufacturing Company is further prepared to furnish the best adapted storage cells and motors to those desiring the complete outfit for motive purposes, and also the most economical and effective storage cells for electric lighting.

SEND FOR OUR CIRCULARS.

Electric Light Fitting.

A Hand-book for Working Electrical Engineers,

EMBODYING PRACTICAL NOTES ON INSTALLATION MANAGEMENT.

By JOHN W. URQUHART.

Chapter I. Central Station Work.
Chapter II. Localizing Dynamo Faults, and Observations Respecting Accumulators.
Chapter III. Switchboard and Testing Work.
Chapter IV. Arc Light Wiring and Fitting.
Chapter V. Wiring for Incandescent Lamps.
Chapter VI. Incandescent Lighting of Ships.
Chapter VII. Miscellaneous Information.

226 PAGES, NUMEROUS ILLUSTRATIONS.

Price, $2.00.

SENT TO ANY ADDRESS ON RECEIPT OF PRICE.

ELECTRICAL REVIEW,

13 Park Row,

P. O. Box 3329. **NEW YORK.**

PRACTICAL WORKS.

BY ROBERT GRIMSHAW, M. E.

ON

STEAM ENGINE, STEAM BOILER, PUMPS, ETC.

STEAM ENGINE CATECHISM.

PART I.....$2.00
PART II.....$1.00

U. S. GOVERNMENT ENDORSEMENT.

NAVY DEPARTMENT, BUREAU OF STEAM ENGINEERING, WASHINGTON, D. C., Nov. 16, 1888.

I am of the opinion that for the practical instruction of engineers, students and young engineers, they are of great value, besides containing many points of use to those older in the profession.

(Signed) G. W. MELVILLE, *Engineer in Chief, U. S. A.*

STEAM BOILER CATECHISM.

PRICE.....$2.00

The most practical, complete and cheapest work on the subject.

PUMP CATECHISM.

PRICE.....$1.00

One of the most useful manuals for the pump runner and user, containing information that can be had in no other shape or place.

PREPARING FOR INDICATION.

PRICE.....$1.00

Gives complete instruction how to get everything in readiness for indicating an engine, and should be in the hands of every engineer.

ENGINEERS' HOURLY LOG BOOK.

PRICE.....50 Cents.

By the use of this book the engineer's work will be rendered more intelligent and be subject to better supervision.

Copies of any of the above books will be promptly mailed, POSTAGE PREPAID, to any address in the world, on receipt of price. Remit by Express or Post Office Money Order, Postal Note, Draft or Registered Letter.

ADDRESS:

ELECTRICAL REVIEW,

13 PARK ROW, New York.

CROSBY ELECTRIC COMPANY.

PRINCIPAL OFFICE,
87 & 89 SOUTH FIFTH AVENUE, NEW YORK.

CROSBY DRY BATTERIES

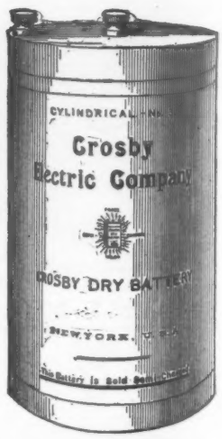
FOR OPEN CIRCUIT WORK.

ELECTRO-MOTIVE FORCE, 1.55 VOLTS. CURRENT, 1 TO 15 AMPERES.

RECTANGULAR, CYLINDRICAL, TELEPHONE.

MADE IN ALL SHAPES AND SIZES.

RECUPERATE OFTENER AND QUICKER THAN ANY OTHER.



NEAT. = CLEAN. = EFFECTIVE. = SIMPLE. = COMPACT. = PORTABLE.

IT IS THE BEST ON THE MARKET.
IT HAS MORE ADVANTAGES THAN ANY.
IT IS SOLD SEMI-CHARGED.
IT DOES NOT DIE ON THE SHELF.
IT IS NOT AFFECTED BY TEMPERATURE.
IT IS NOT DESTROYED BY SHORT CIRCUIT.
IT IS THE MOST RELIABLE.
IT PERFORMS THE MOST WORK.

FOR TELEPHONES, ANNUNCIATORS, GAS LIGHTING, HOUSEWORK, MEDICAL PURPOSES.

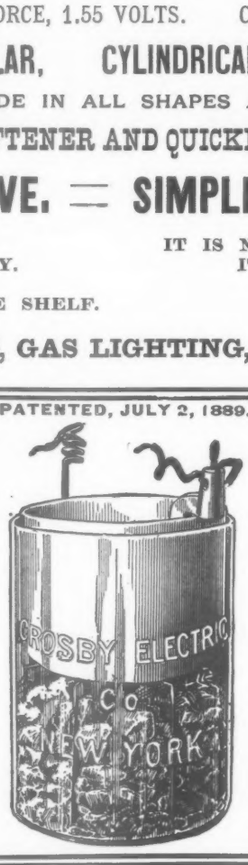
PATENTED, JULY 2, 1889.

THE HUSSEY BLUE STONE.

The Only Blue Stone Battery that can be used for open circuit work.

No Consumption of Blue Stone when not in use.

For Charging Storage Batteries, Running Sewing Machines, Small Incandescent Lamps, Fans, Dental Machines, Telegraphing.



Can be completely recharged without dismounting.

No Deposit of Copper on Zinc.

Gives 10 Times the Current of Any.

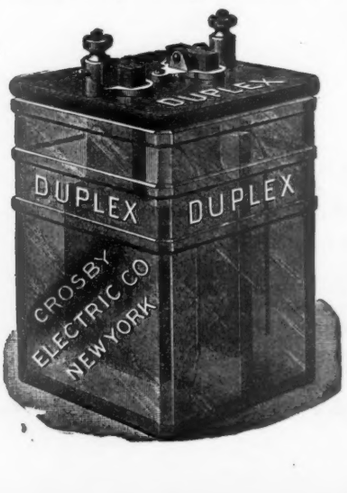
For Running Motors.

For All Uses.

THIS IMPROVEMENT CAN BE APPLIED TO ALL FORMS OF BLUE STONE JARS AT PRESENT IN USE.

THE DUPLEX.

Its two cells occupy only the space of one, thereby giving a voltage in the space of one cell, equal to that obtained by any other two cells requiring double the space.



**For Housework,
Bells,
Burglar Alarms,
Etc.**

No Climbing Salts.

Always Clean.

Recuperates Quickly.

Large Zinc Surface.

Is rapidly taking the place of all other Open Circuit Liquid Batteries.

THE ECLIPSE.

Intended for Close Circuit Work.

Will Not Polarize.

Pure Water only Necessary to Charge It.

The Simplest and Cleanest Close Circuit Battery in the World.

No Fumes.

No Odor.

For Small Motors.

Small Lamps.

For Doctors' and Dentists' Use.

Induction Coils, Etc., and all purposes where a Constant Current is required for continuous or intermittent work.